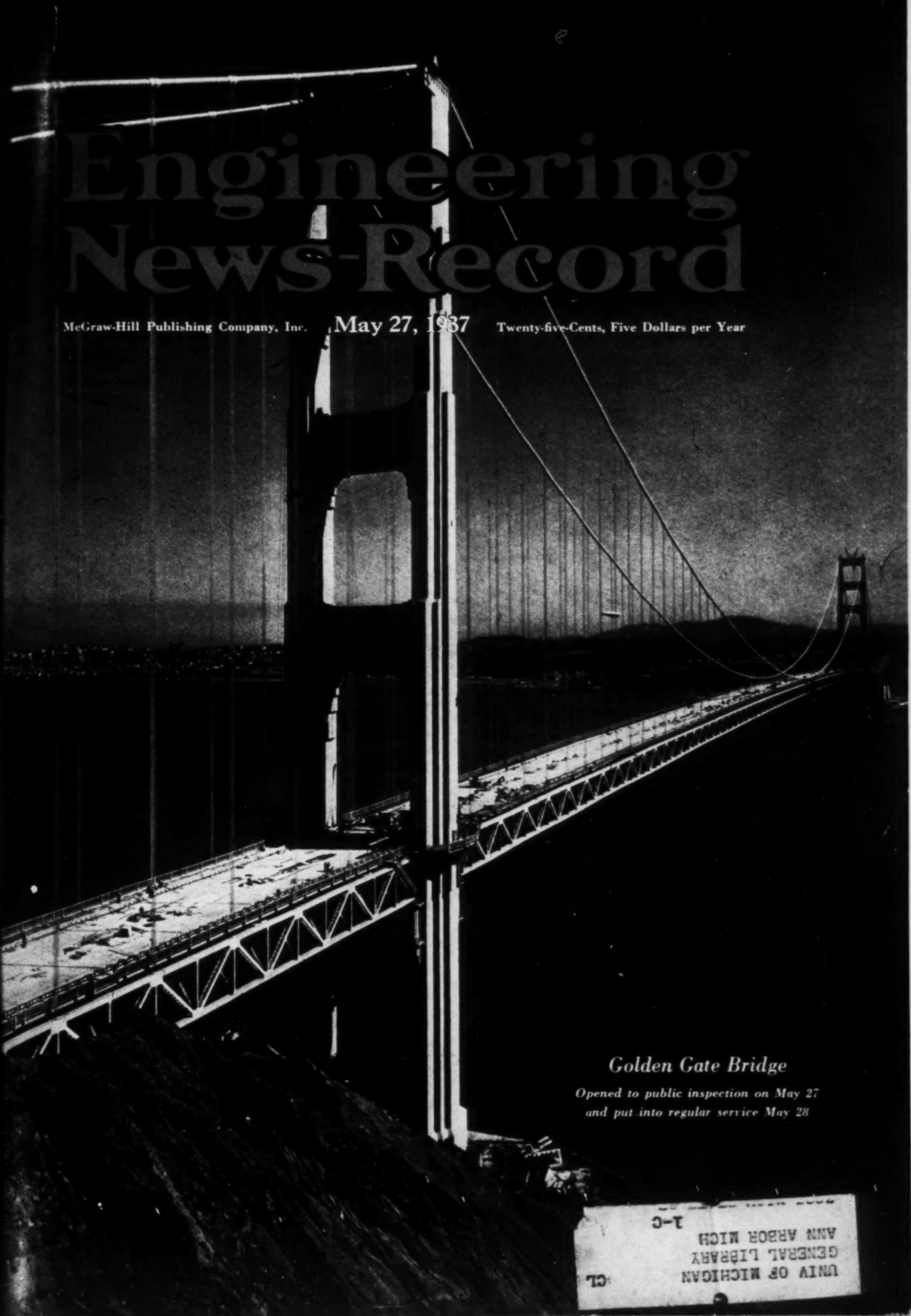
Engineering News-Record

McGraw-Hill Publishing Company, Inc. May 27, 1937 Twenty-five-Cents, Five Dollars per Year



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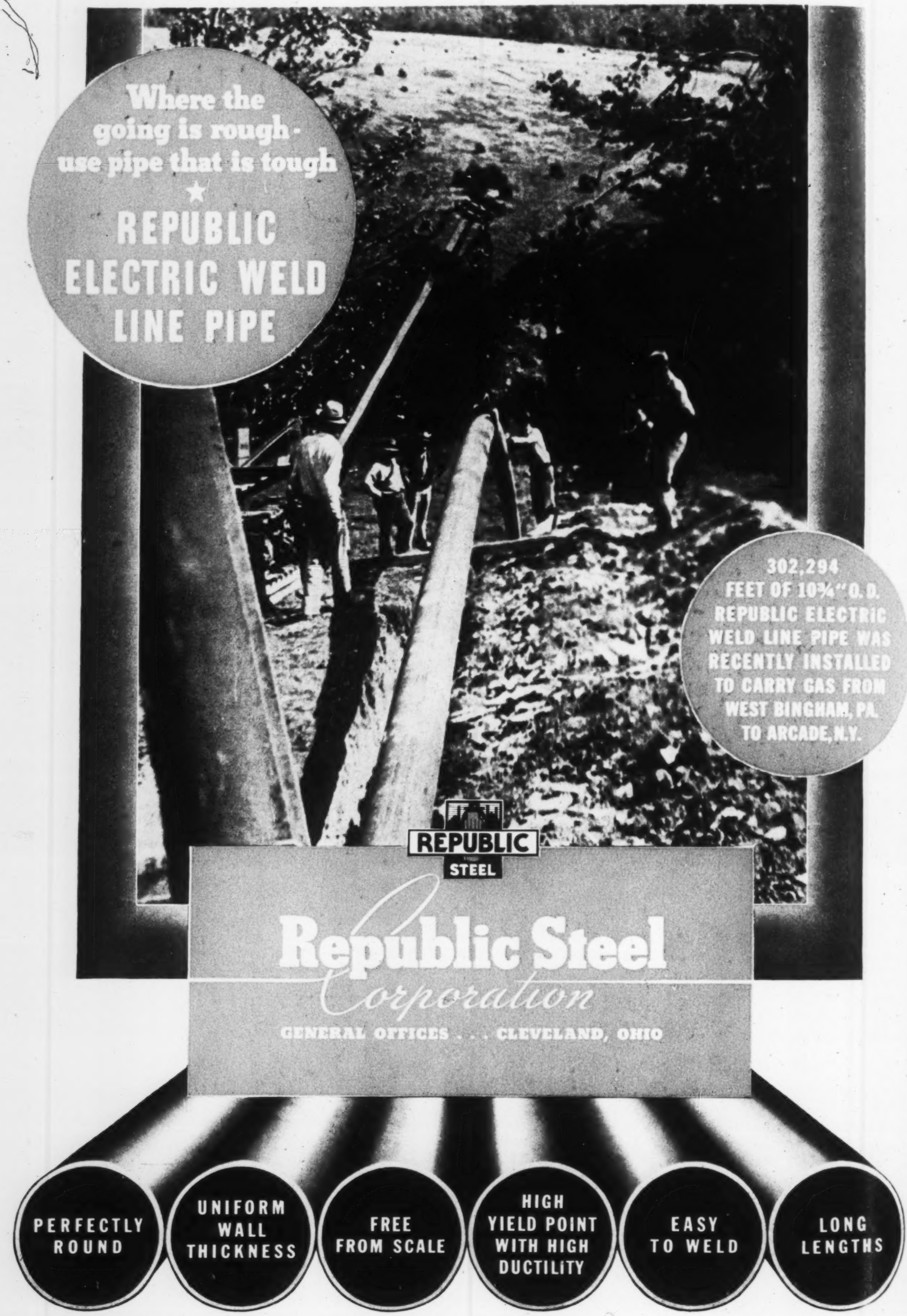

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— — THE PUBLISHERS' PAGE — —

New Tools Breed New Practice

ANTICIPATING the Buffalo convention of the American Water Works Association, *Engineering News-Record,* in its next issue, will take special note of the current and prospective concerns of waterworks builders and operators.

In appraising those concerns it becomes evident that the provision of adequate and satisfactory water today must rate as "Big Business" in municipal administration. Of that business every city dweller is a customer and, in the case of publicly owned works, a stockholder as well.

Like every other industry, water supply today is faced by the post-depression need to overhaul and modernize its operations in order to meet the growing demand for its services and the more exacting standards of its consumers.

Needless to say, an important factor in meeting this need must be superior management and administration. This includes sound organization for advanced planning and current operation and better records and accounting practice; for trustworthy knowledge of performance and costs is the raw material of good management. Uniform standards for such records makes possible the comparative study that alone gives life and utility to statistics, and makes them useful in gauging achievement relative to other plants and to one's own past performance.

BUT, assuming these adjuncts of good management, it is evident that the physical plant for collection, conveyance, storage, processing and distribution is of major importance at this time. During recent years the actual improvement of many facilities may have marked time; but, in their laboratories and designing offices, the manufacturers of waterworks materials and equipment constantly have sought out new values in terms of economy, security and dependability. These new tools now become capital factors in current waterworks practice.

The waterworks man of today must be able to use these tools expertly. To be sure, he must have his fundamental training in hydraulics and in the design of his various service structures; he must be chemist and bacteriologist so far as these sciences may serve his field; he must be a capable administrator of operation and maintenance: these, as always, provide the technical foundation of his practice.

But unless, in addition to these, he has also a comprehensive and accurate familiarity with the tools and instruments of that practice, he must fall far short of what his clients expect of him. His service must be rendered in terms of pumps, engines, motors, pipe, tanks, valves, meters, treatment and a whole arsenal of other equipment, as well as in terms of technical principle. He must know intimately what tools are available to keep his mains clean and to search out and curb the leaks and other losses that swell the citizen's water bill. Like the surgeon, he must know these instruments to a nicety if he is to use them skillfully for the well-being of his clients.

Unfortunately, such knowledge is not static. It cannot be acquired once and for all and then used indefinitely. For modern practice here, as in every other technical field, is a race between the makers and the users of tools. Principles may remain constant but the tools by which they are applied do not. And a practitioner's value is determined not by what he knows of principle but by his skill and resourcefulness in practice.

THE waterworks man, like his fellow technicians in other industries, must go to school as long as he remains in practice. And in his school the course in "Equipment, Tools and Materials" becomes ever more important to him as manufacturers constantly improve and multiply their products and services. The essence of every technical art still remains "what to do, how to do it and what to do it with." And of these three, the last looms ever more significant.

In this belief, *Engineering News-Record* dedicates its next issue—in both editorial and advertising content—to the progress of waterworks practice and to the service of waterworks men in every department of their very live and active field.

Willard Chevalier

ENGINEERING NEWS-RECORD Published every Thursday. Vol. 118, No. 21. Price 25c per copy. Subscription, domestic, Canada, Mexico, Central and South American countries, $5 per year. All other countries, $9 a year or 36 shillings. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C.

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Editorial and Executive Offices: 330 West 42d St., New York. Publication Office: 99-129 N. Broadway, Albany, N. Y. Branch Offices: 520 N. Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

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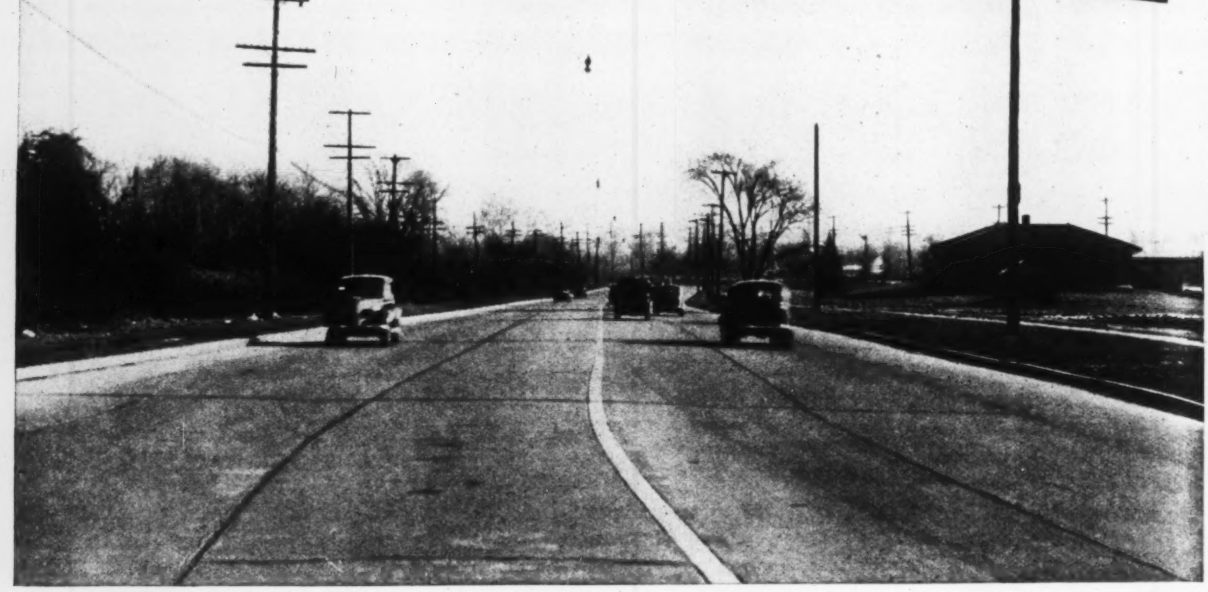
Burying a Railroad— and building an express highway along New York City's Hudson River waterfront is one of the nation's largest construction jobs, giving new meaning to "grade crossing elimination". Intensive park development also accounts for some of the $25,000,000 being spent on the current phase of the work. The project will be described in articles beginning in the June 10 issue.

FROM HIS SIMPLE IDEA CAME TODAY'S *Permanent Safety Marker*

Edward N. Hines

Board of County Road Commissioners, Wayne County (Detroit), Michigan

"To Edward N. Hines, in recognition of his notable contribution to highway safety through the introduction of the center traffic line now in universal use" —reads the plaque presented by the B. F. Goodrich Company in 1936. The plaque was presented to Mr. Hines only after the Goodrich Company had searched the entire country to determine the originator of the center traffic line idea.



Traffic markers and curbing of Atlas White Portland Cement in Michigan Superhighway, near Dearborn. Installed by Board of County Road Commissioners, Wayne County. J. K. Norton, Road Engineer.

EVEN as far back as 1912, traffic had its problems. It was in that year that Edward N. Hines of the Wayne County Road Commissioners, (Detroit), Michigan — aiming at the "road hog" — hit on the idea of running a white stripe down the center of roads and streets.

A simple idea — yet one of the most important contributions to traffic safety ever made. From it came the permanent safety marker of portland cement. Today traffic markers made of Atlas White Portland Cement form safety lanes for many thousands of miles of country and city traffic.

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ATLAS WHITE PORTLAND CEMENT
FOR TRAFFIC MARKERS

ENGINEERING NEWS-RECORD

May 27, 1937

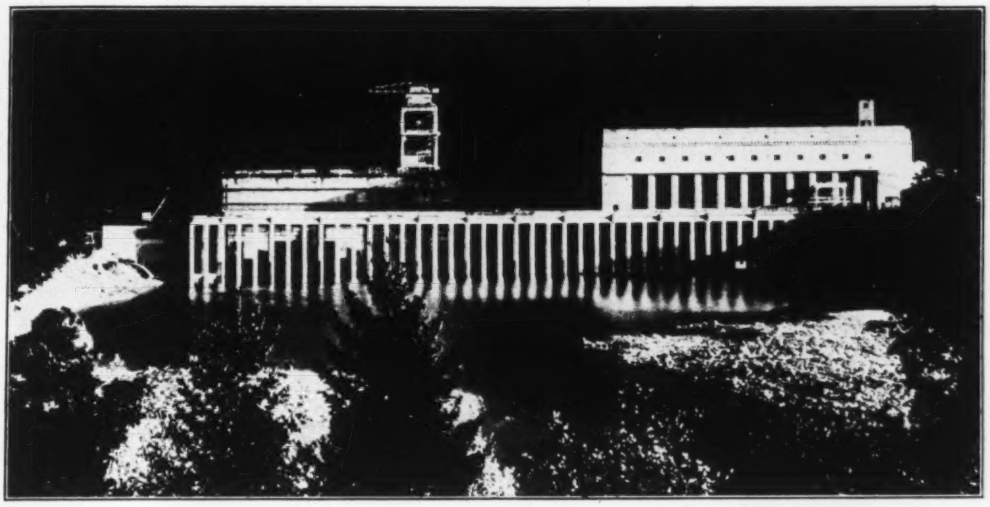


FIG. 1—BONNEVILLE POWER HOUSE, as seen at night from the downstream side. Two 66,000-hp. units are being installed now. The plant occupies Bradford channel on the Columbia River.

Kaplan Turbines For Bonneville

Wide range of head under which the power plant must operate at Bonneville Dam on the Columbai River makes adjustable-blade runners mandatory if high efficiencies are to be obtained continuously

By C. C. Galbraith

Senior Civilian Engineer, Bonneville Project Portland, Ore.

CONSTRUCTION now is in the final stages in the powerhouse of the Bonneville project on the Columbia River about 40 miles from Portland, Ore. The building and the water passages beneath it are practically completed, auxiliary equipment has been installed and only erection of turbines, generators, switching structure and controls remain to be finished before the plant may go "on the line." That event now is scheduled for early in 1938.

The turbines are of larger dimensions than any previously built in the United States and are the highest-power turbines of the Kaplan type ever built (66,000 hp.). Because of their great size these units raised special design problems to avoid cavitation and to keep the weight on each thrust bearing within safe limits. Mechanical difficulties also were introduced in manufacture of the turbines and construction difficulties in building the large water passages. How these problems were solved, and the resulting elements of design, are set forth in the following.

The combined powerhouse and intake structure at Bonneville extends entirely across Bradford channel, south of Bradford Island. In effect this structure is a non-overflow dam of which the powerhouse is an integral part, built of reinforced concrete. The plant now is being completed for two main units and auxiliaries. A skeleton structure for four more units has been built, but provision has also been made for ultimate extension to include a total of ten or more units as storage is developed in the upper Columbia River basin. A navigation lock is just south of the powerhouse. On the north side of Bradford Island is the main channel of the Columbia, occupied by the main Bonneville dam, which has a spillway over practically its entire length.

The powerhouse structure as completed for two units is 207 ft. wide and 280 ft. long. In height the building extends from El. —62.0 in the unwatering pump room to El. +127.0 on the parapet, a total of 189 ft. Towering 78 ft. above the parapet will be the high voltage switching structure, from which the transmission lines will lead toward the west.

In the plant the main generator room is 75x274 ft. in plan, with a clear height of 55 ft. An indirect lighting system is used throughout the building and at roof truss level in the generator room a suspended ceiling, unusual in this class of work, was put in as a reflecting surface. Except for the part of the room at the south end which is reserved for erection purposes, the floor and wainscoting will be of tile. The entire floor area is designed for a live load of 1,000 lb. per sq.ft. so any portion of it may be used for erection purposes.

Selection of turbines

Columbia River records for the last 58 years indicate that the flow varies from 40,000 sec.-ft. corresponding to a working head of 67 ft., to 1,170,000 sec.-ft., at which flow the available head would be only 23 ft. The weighted average head is 54 ft. Probability curves indicate that the maximum flow of 1,170,000 sec.-ft. may be expected only once in each 400 years, so that this condition need not control the design. The duration curves show that the development of ten units of 60,000 hp. each, which is the ultimate plant capacity contemplated, can be operated as a base-load plant for a large percentage of the time. Ample daily pondage is available in the forebay and with the development of storage at Coulee Dam and other upstream points ten units can operate at their full rated capacity all of the time during periods of normally low streamflow.

During flood periods, however, with enormous quantities of water available, the plant output will be limited by the maximum capacity of the turbines at the corresponding low head, and it is evident that under this condition the turbine should be able to use large quantities of water so as to produce maximum output, regardless of efficiency.

The necessity, then, of securing a high efficiency over the wide range of heads under which the plant normally will operate, in addition to the governing requirement of high capacity at low heads, left no choice but an adjustable blade runner. Accordingly, the Kaplan type, with blade angle and gate openings automatically adjusted to the net head available, was selected.

The automatic adjustments are accomplished as follows: Water levels, from still-wells located at headwater and tailwater, are transmitted electrically to a device in the control room which interprets and records in terms of net head. The net head then is transmitted electrically to the governor of each unit. Movements of the cams regulating the relationship of wicket gate opening and runner blade angle for maximum efficiency at any particular head and for the particular load carried are governed by the net head.

Turbine size was governed by practical considerations. Space available, the fact that the ultimate number of units would be large, economy of construction and operation, and the fact that the project undoubtedly will operate as a base-load plant, all indicated the desirability of units as large as feasible. Considerations which limited the capacity to about 60,000 hp. were:

(a) Difficulties in design and construction of very large concrete water passages, with consequent increase in cost;

(b) The large and expensive powerhouse structure, requiring long spans for the cranes;

(c) Difficulties in securing smooth flow in the large water passages, and possible tendency to cavitation;

(d) Mechanical difficulties in casting, machining, shipping and erecting the large parts required;

(e) Operating risks attendant upon carrying too great a weight on one thrust bearing.

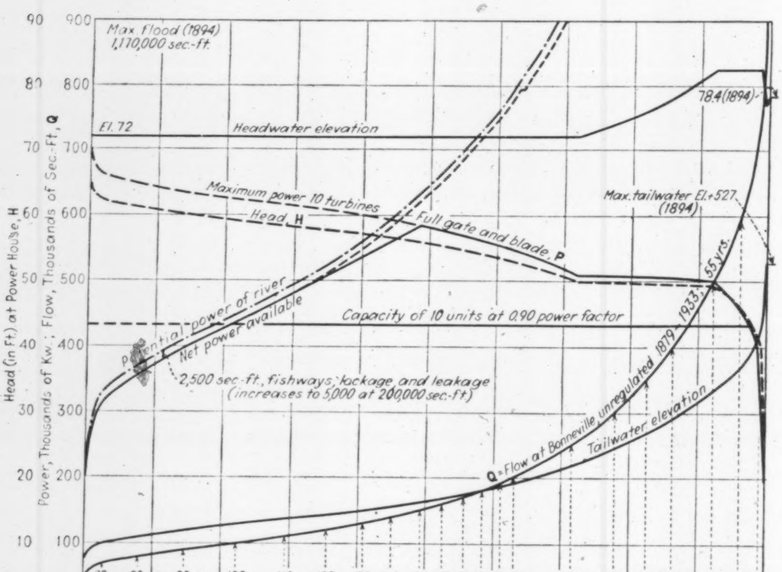


FIG. 2—**POWER DURATION CURVES** for the Kaplan turbines at Bonneville.

Model tests

After decision was reached on capacity and type of turbine, an exhaustive series of model tests was begun in the U.S. Engineers' hydraulic laboratory at Portland, Ore. These tests indicated that for water passages of the size required the splitter type of elbow draft-tube, with the tube divided both vertically and horizontally by large concrete "splitters," inherently has greater stability and more freedom from surges than do other types tested. Because the result was greater efficiency, this type of tube was adopted.

Tests of models of the intake and scroll case (which are practically one water passage) led to the adoption of the island type of intake, in which the water flow is directed and distributed by several large streamlined piers.

Tests also were conducted with larger models by the turbine manufacturer as part of his contract. A final check test was run on models in the hydraulic laboratory at Holtwood, Pa. The resulting efficiency curves (Fig. 3) indicate an over-all efficiency of 92.8 per cent at a capacity of 60,000 hp. A remarkably flat efficiency curve obtained over the range of heads tested.

Large water passages

The draft tubes, scrolls, and intakes are constructed entirely of reinforced concrete; the upper portion of the draft tube is lined with steel. The splitters and sharp piers are fitted with steel nosings on the upstream edge.

The enormous size of these water passages is worthy of special note; the width of the intake for each unit is 74 ft. With water at the proper level, it would be practicable to operate a

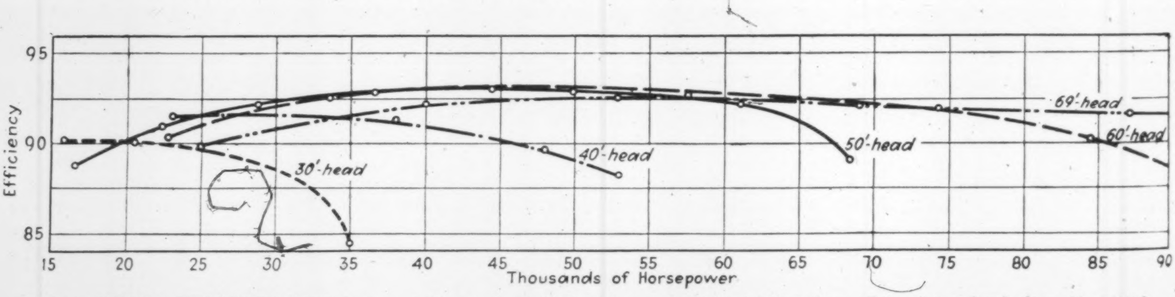


FIG. 3—**MODEL PERFORMANCE** curves recording tests at Holtwood on a 15.97-in. turbine show efficiencies at heads from 30 to 60 ft.

small boat in most of these spaces, and, if the gates were removed, even between the vanes of the speed ring.

Improved turbine designs

The design of the turbine parts includes several distinct advances over previous practice. Speed rings, bottom plates and throat rings all are welded from pressed plates. The welding procedure used in this work was selected after an exhaustive investigation by the manufacturer. Alternating current was used in the welding arc and all work was done with the weld as nearly as possible in a horizontal position; the parts were rotated as necessary.

The runner blades of one unit are being machined by actually cutting the finished surface to the true theoretical shape of the blade; the blades of the other are given the usual ground finish. Thus any benefits that result from the machining, such as increased efficiency, smoother running, and reduction of cavitation, will be brought out by comparison of operating records. This is expected to determine whether the expense of this refinement is justified in future units.

Each unit has five runner blades projecting radially from the runner hub. Both hub and blades are of cast steel. The blades are reinforced at points of greatest wear and, where a tendency to cavitation might be expected, a heavy layer of stainless steel has been deposited by the arc weld process. The runner hub, 10 ft. in diameter, is hollow and contains blade operating mechanism immersed in a bath of heavy lubricating oil: 3,000 gal. of oil is used in one filling.

In order to prevent entry of water into the oil chamber within the runner hubs, the lubricating oil within is kept under pressure and the pressure can be so adjusted that at all times it will be slightly above that in the tailwater. This is accomplished by mounting an oil tank, air compressor, and motor on the turbine shaft where they revolve with the unit. To reduce leakage of oil from the hub, each runner blade is fitted with a stuffing box. Shop tests, made with the hub assembly under oil pressure, indicate that leakage will not be more than 3 gal. per unit per month of operation. This method of keeping the hub lubricating oil at tailwater pressure is being used for the first time at Bonneville.

The thrust bearing which carries the combined weight of rotating parts in turbine and generator, a total of 2,068,000 lb., is of the spring cushioned, self-aligning type with an over-all diameter of 9 ft. 4 in. These bearings are being made by the General Electric Co.

Provision is made for introduction of compressed air into the upper portion of the draft tube at times of sudden load loss. At such times the wicket gates close and the Kaplan blades turn to the closed position. The introduction of air at this time is not, as might be supposed, for the purpose of avoiding a vacuum and the resulting water slam. It is unnecessary for that purpose, but is needed to prevent upward thrust on the turbine blades from lifting the combined weight of the rotating turbine and generator parts off the thrust bearing. Two compressors have been installed to supply this service, each with a capacity of 675 cu.ft. of free air per minute.

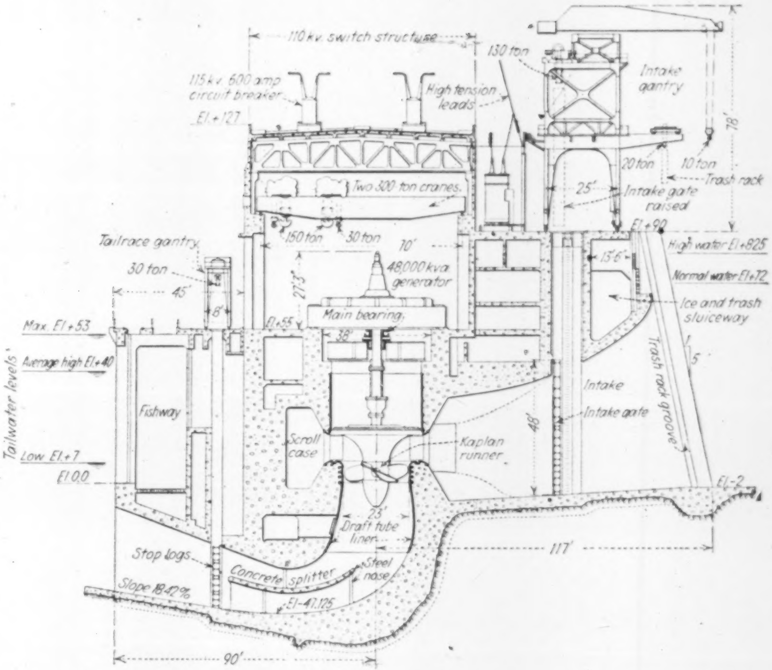


FIG. 4—CROSS-SECTION of power house showing turbine, intake and crane equipment. The ice and trash sluiceway is a notable elment of the intake.

TABLE OF COMPARATIVE DIMENSIONS ON LARGE KAPLAN TURBINES

Location	Dia. of Runner	Head (ft.)	Flow Req'd.	Horsepower
Bonneville, U. S. A.	23′ 4″	50	14,000	66,000*
Safe Harbor, U. S. A.	18′ 4″	55	8,000	42,500
Ryberg, Switzerland	23′ 0″	37.7	10,420	38,700
Svir, U. S. S. R.	24′ 4″	36.1	10,240	37,500
Dogren, Switzerland	23′ 0″	35.1	10,600	35,500
Vargon, Sweden	26′ 3″	14.1	11,090	15,200

* The Bonneville turbines are designed for a normal rating of 60,000 hp. with maximum efficiency, but with a maximum rating of 66,000 hp. to be used when the generators are operating with full load, at unity power factor.

Actuators

Governors for the main units are enclosed in an actuator cabinet located on the generator floor. The governor operates valves which are connected with the governor oil pressure system operating at 300 lb. per sq.in. Oil pressure pipes lead to the servomotors in the turbine pit, which operate the gate shifting ring, and to the Kaplan head. The Kaplan head is mounted above the generator and oil pressure is transmitted from this point through rotating pipes in the shaft to the blade servomotor, which is enclosed in a section of the shaft just above the top plate. From the servomotor, the blade angle is controlled by a mechanical connection operating through the shaft.

The two main generators now are in process of erection in the power house. Because of their large size, which made shipment of the assembled parts impossible both rotors and stators are being assembled in the field. These units are rated at 13,200 volts, 48,000 kva. and are equipped with enclosed-type surface air coolers. They run at 75 r.p.m. but are designed for and are to be tested at a runaway speed of 216 r.p.m. The over-all diameter of the generator housing is 48 ft.

The station service unit has a 5,000-hp. Kaplan type runner with manually adjustable blades. Provision has been made for conversion to fully automatic operation if this should be found desirable in the future. The service unit generator, as well as the turbine, now

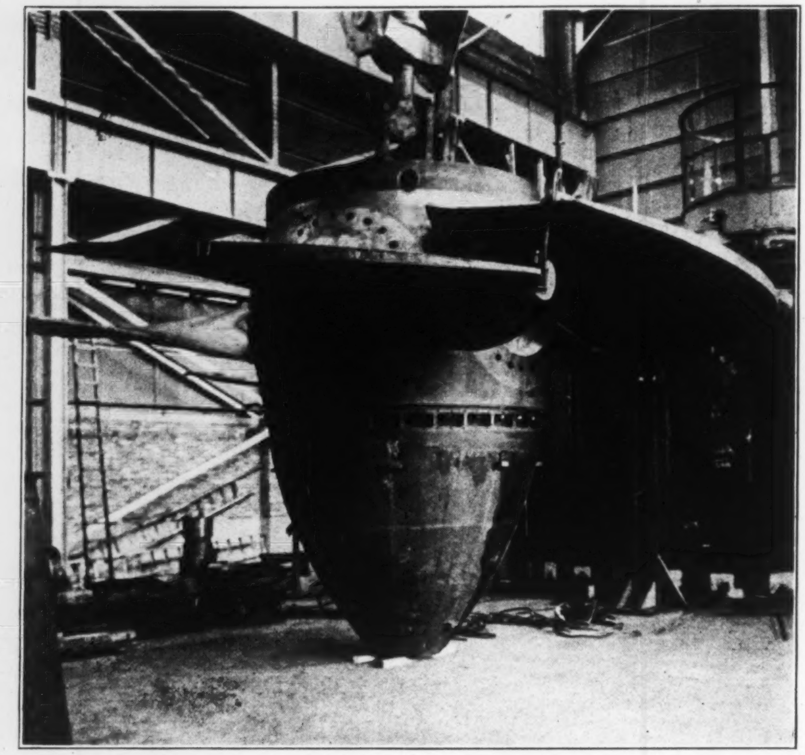


FIG. 5—THE TURBINE RUNNER has blades of adjustable pitch, is 23 ft. 4 in. in diameter and carries 3,000 gal. of oil in the hub.

is in place and ready for operation as soon as the forebay is filled to operating level. The generator is rated at 5,000 kva., 2,400 volts and is equipped with enclosed air coolers. This unit runs at 256 r.p.m., but is designed to withstand the runaway speed of 750 r.p.m. without damage.

The generator room is equipped with two 300-ton bridge cranes, each with two 150-ton hooks as well as a 30-ton auxiliary hook. These cranes may be coupled and used as one unit, all four 150-ton hooks operating through equalizing lifting beams to lift a maximum single load of 550 tons. The weight of the lifting beams is approximately 50 tons.

Pumping equipment consists of two 5,000-g.p.m. pumps for unwatering the draft tubes in addition to the usual drainage and station service pumps. Two electric elevators are provided to give access to the different floors of the station.

Intake design

The intake for each unit is divided by intermediate piers into three water passages each 21 ft. wide. Steel gates close these openings when required; one roller gate and two sliding gates are provided for each of the two units now being installed. These gates are handled by the intake-gate gantry crane, of 130 tons capacity. This crane also is equipped with a 10-ton hammerhead boom for miscellaneous work, as well as with hoists for handling the trash rakes. Due to the large water passages through the turbines, the spacing of streamlined trashrack bars is 6 in. on centers. The racks are designed to withstand 20 per cent of full hydrostatic pressure.

A trash and ice sluiceway, Fig. 4, which has a maximum capacity of 2,400 sec.-ft. discharges into the tailrace. It was designed to handle trash and ice floating on the surface and refuse taken from trash racks by the automatic rakes. At times of high water, when a large quantity of debris is carried by the current or when ice is running, the upper 18 in. of the water will be allowed to carry flotsam into the sluiceway. During times of normal flow, the sluiceway weir gates will be partly opened, allowing fingerling salmon, which ordinarily swim near the surface, to go on down the river without passing through the turbines.

The gate openings in the intake through which water for future units will pass have been closed with precast concrete stoplogs which weigh about 30 tons each. In each gate slot there are ten of these stoplogs, 21 ft. long by 5 ft. high and 3 ft. 3 in. thick. Joints between the individual logs are made tight by tongue-and-groove edges. These joints fit perfectly because top and bottom edges of alternate logs were used as forms for the precasting of the intermediate logs. Fir strips bolted into recesses cast in the concrete are used as water seals at the ends of each log. So far as the author knows, this is the first time concrete has been used for stoplogs.

Electrical control

The plant normally will be operated from the control room, but if necessary or desirable the units can be operated from the control cubicles on the generator floor at El. 55.0. The control room overlooks the generator room, with double glass windows intervening, and is soundproofed. The control and office section of the building is equipped with a modern air conditioning plant.

Transformer banks, to step the generator voltage up to 110,000, are located on the inboard side of the intake deck, whence high-tension conductors

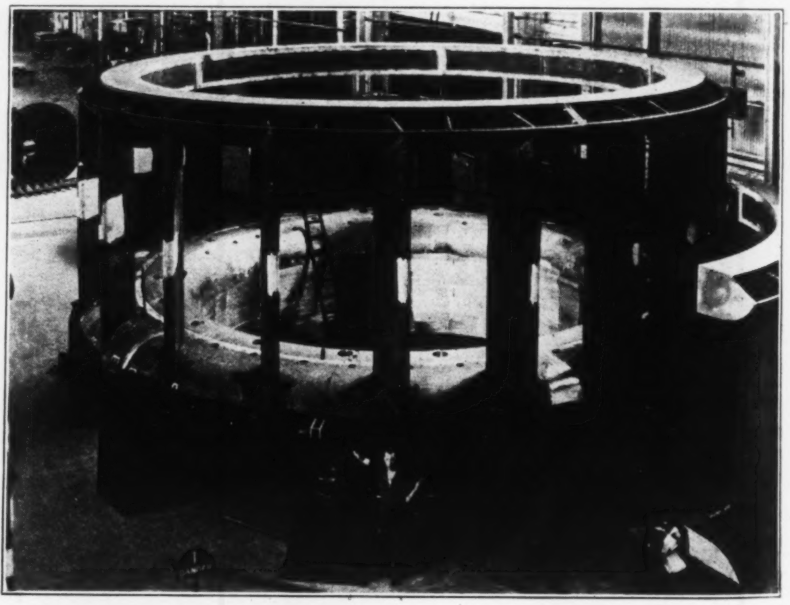


FIG. 6—THE SPEED RING, as assembled in the shop before shipment.

lead up to a high voltage switching station on the powerhouse roof. This roof has a concrete deck. Severe ice conditions, which at times prevail in this region, made it advisable to design transmission lines and switching station for a 2-in. ice coating on all conductors and exposed surfaces.

Personnel

Design and construction of the Bonneville project has been carried out by the Portland Division of the Corps of Engineers, U.S. Army. Col. T. M. Robins is division engineer, Lieut.-Col. C. F. Williams is district engineer and Capt. Colby M. Myers is resident engineer at Bonneville.

Civilian engineers connected with the project are: C. I. Grimm, head engineer; A. E. McKennett, principal engineer; C. C. Galbraith, senior engineer in charge of powerhouse and power plant design; L. E. Kurtichanof, engineer in charge of electrical design; and B. E. Torpen, senior engineer on the construction of the project. Consulting engineers were L. F. Harza and J. P. Hogan on structural and hydraulic features and G. W. Hamilton on electrical design. The Kaplan turbines are being built by the S. Morgan Smith Co.

Concrete Wall Broken Up By Many Small Powder Charges

REMOVAL of a concrete retaining wall was part of the work incidental to widening the Pacific Highway in the approach from the south to Oregon City, Ore. The quickest and best means of breaking up the wall would be by use of powder, it was decided, whereupon the major question became the size and spacing of powder charges to be used. Data on this and other features of the work are given in the following. Appearance of the concrete before and after the blast is shown in Figs. 1 and 2.

The structure was a gravity type, plain concrete retaining wall built to support the old railroad fill immediately adjacent to the business section of the city. It had a maximum height of 18 ft., top width 1½ ft. and base thickness of four-tenths the height or a maximum of 7.2 ft. It extended about 200 ft. along the railroad. To secure more width and an easier skew angle for the underpass beneath the railroad it was necessary to remove part of the retaining wall. Prior to removal of the wall, piling was driven in the fill and caps and stringers were worked into place beneath the railroad tracks. This temporary track support was provided to prevent interference with use of the tracks after removal of the wall and pending completion of the new highway improvement. The temporary track supports were not damaged by the blast.

Procedure

The powder charges were placed in holes drilled downward in the concrete from the top of the wall and also in holes drilled into the exposed face of the concrete. The down holes from the wall top were spaced on 4-ft. centers and were drilled to a depth of 6 ft. At a point 8½ ft. below the top of the wall holes were drilled in from the face 2½ ft. apart in both directions and were inclined slightly downward. These holes put in from the face were drilled to within 1 ft. of the back of the wall. Thus the depth of the holes increased with the thickness of the wall toward the base. All holes were 2¼ in. in diameter.

No springing of the holes was attempted. One and a half sticks of 40 per cent dynamite were placed in each of the holes, the same in those put down from the top as in those driven from the face. The powder then was tamped with sand and on top of the tamped sand a second powder charge was placed in all face holes. For this second charge three additional sticks of powder were placed in each face hole of the top row and the charge was increased to six sticks in face holes of the bottom row. These second charges were approximately in the center of the wall. The quantity of powder used was slightly less than ½ lb. per cubic yard of concrete.

All the powder charges were fired simultaneously with electric detonators. The result of the blast was a very satisfactory breaking up of the concrete into chunks convenient for loading into trucks as shown in Fig. 2.

The blasting was done by the contracting firm of Parker & Schram by whom the contract for road widening was held. The project as a whole is under the direction of R. H. Baldock, Oregon State Highway engineer.

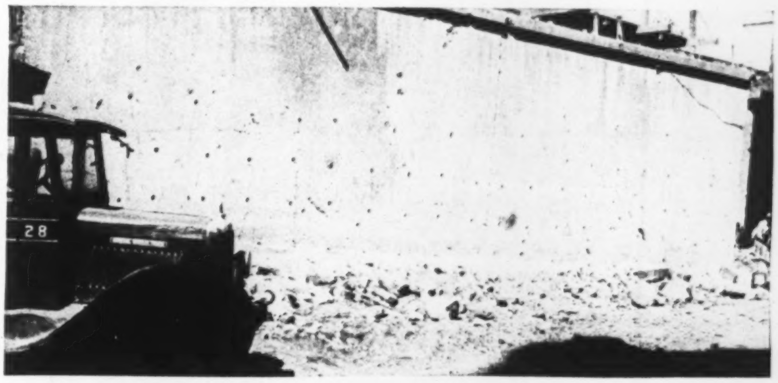


FIG. 1—RETAINING WALL prior to the blast. Drill holes can be seen in the face of the wall.

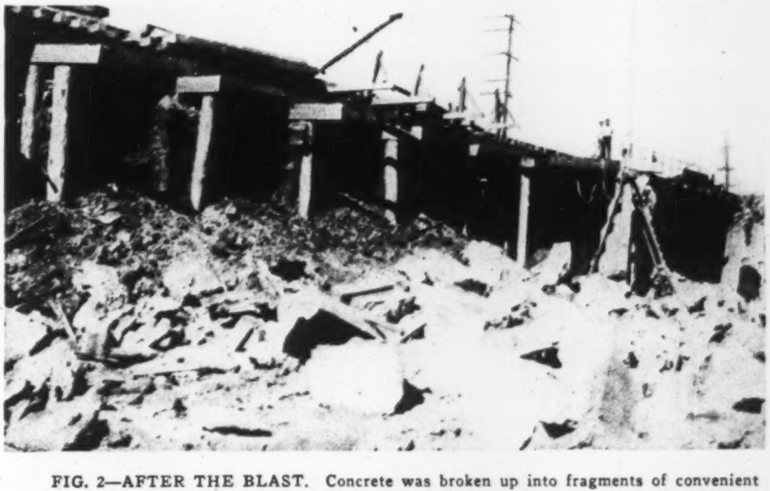


FIG. 2—AFTER THE BLAST. Concrete was broken up into fragments of convenient size and yet there was no damage to the timber structure which was installed to support the railroad temporarily.

Bay Bridge Rapid Transit System

San Francisco-Oakland Bay Bridge transit system will have large terminal capacity and elaborate train control to make possible the handling of 56 trains per hour each way at times of peak load

By C. H. Purcell, Chas. E. Andrew and Glenn B. Woodruff,
Respectively Chief Engineer, Bridge Engineer and Engineer of Design, San Francisco-Oakland Bay Bridge

TRANSBAY traffic of 50,000,000 passengers annually, with 17,000 passengers in one direction in a 20-min. peak, formed the basis for designing interurban railway facilities of the San Francisco-Oakland Bay Bridge. As the bridge design provides for only one track in each direction (*ENR*, Mar. 22, 1934, p. 373), handling peak traffic of this volume with a seat for every passenger requires 10-car trains operating on a 65-sec. headway.

Between San Francisco and East Bay cities passengers now are carried by two companies, the Southern Pacific and the Key System, which operate ferries on the Bay connecting with electric interurban trains radiating to various parts of the East Bay territory. Southern Pacific interurban trains take power from a 1,350-volt catenary; the Key System is supplied by a 625-volt catenary. A third company, the Sacramento Northern Ry., operates a suburban line to the north, reaching San Francisco by means of rights on the Key System tracks and ferries.

The plan developed for interurban train service over the Bay Bridge provides that these companies shall discontinue their ferries and operate trains on the bridge under a rental agreement with the California Toll Bridge Authority, which is to finance, in addition to facilities required on the bridge, such alterations to the equipment of the three companies as may be necessary. Interurban facilities, which are being provided as part of the project carried out by the California Toll Bridge Authority, include the San Francisco passenger terminal, the viaduct between the terminal and the bridge, the trackwork across the bridge, the East Bay yard, connections with the two East Bay rail systems, the power distribution lines and the signal and interlocking systems.

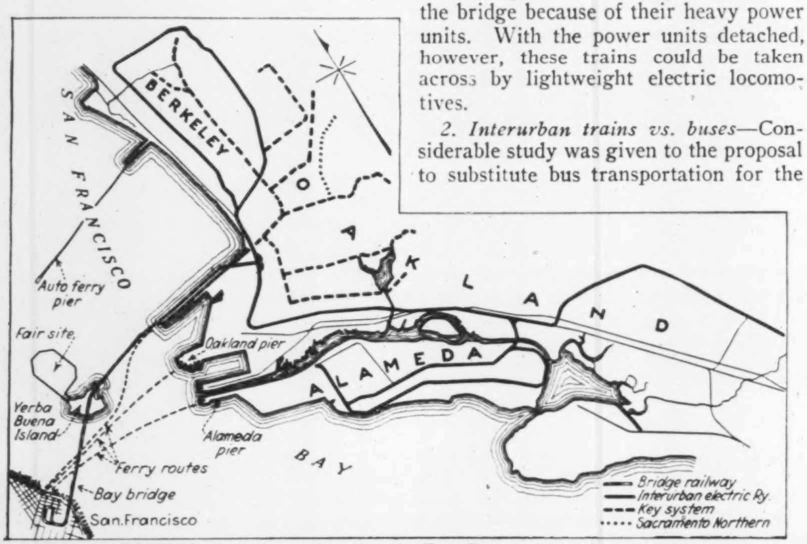


FIG. 1—ROUTES of the interurban lines in East Bay territory as relocated, converge to the Bay bridge.

Preliminary investigations

Before undertaking the design of railway facilities on the bridge the following basic considerations required study:

1. *Provisions for transcontinental trains*—To have provided for standard railroad equipment would have increased the cost of the bridge about $30,000,000, an expenditure that could not be justified economically. Streamlined trains of recent design cannot be operated across the bridge because of their heavy power units. With the power units detached, however, these trains could be taken across by lightweight electric locomotives.

2. *Interurban trains vs. buses*—Considerable study was given to the proposal to substitute bus transportation for the electric railways. Conclusions were that:

(*a*) It would be impossible to operate a bus service with a fare schedule as low as that which has been worked out for the electric trains.

(*b*) Widening streets on both sides of the Bay to accommodate the increased volume of traffic due to the use of buses would cost more than is being spent for the railway facilities on the bridge.

(*c*) An investment of about $20,000,000 in the existing East Bay interurban lines would have to be abandoned if buses were substituted.

3. *Shuttle vs. through service*—Having decided on an electric service, it was possible either to provide a shuttle service across the bridge, transferring to the East Bay lines at the eastern bridgehead or to provide for bringing the East Bay lines across the bridge. The through service was adopted principally to avoid the transfer which is one of the most disagreeable features of the present combination of ferry and electric train service.

4. *Voltage*—The Southern Pacific electric system now operates on 1,350 volts; the Key System on 625 volts. To change the equipment of either company to a common voltage would involve heavy expense and neither company was willing to make the change. As a compromise two power supply systems will be built, an overhead catenary at 1,350 v. for the Southern Pacific and third-rail carrying 625 v. for the Key System.

5. *Distribution in San Francisco*—The distribution problem in San Francisco called for decisions as to whether to provide more than one station and where the station or stations would be located. A single station at First and Mission streets was adopted for the following reasons:

(*a*) The cost of acquiring property closer to Market St., the city's main traffic artery, was prohibitive.

(*b*) Street congestion made it impracticable to turn street cars off Market St., at any point west of First St.

(*c*) The single station brings more than 50 per cent of the passengers within easy walking distance of their destination. Any additional station or

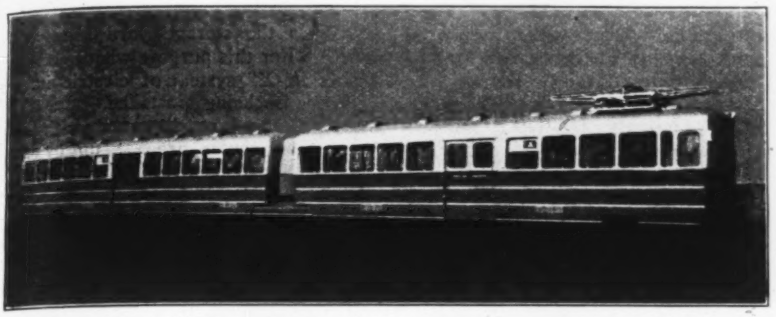


FIG. 2—NEW UNITS for the Key Route System are two-car with a total seating capacity of 124.

stations would serve only a very small number of passengers, and greatly increase the cost of the project.

Terminal and connections

The San Francisco terminal is to be of the loop type. Because of speed reduction on the sharp curves, the incoming track is to be double from Rincon Hill to the terminal. To afford ample time for unloading and loading passengers, to give some leeway in making up time for trains that are behind schedule, and to obviate congestion on the platforms, six tracks with four platforms each 780 ft. long are provided. San Francisco surface cars will make a loop in front of the station, rising on a ramp to the mezzanine level. Three tracks with a capacity of four cars each are to serve this purpose.

The terminal building will be a reinforced concrete, flat slab structure. The roof and the crossings over the streets will be steel rigid frames. The track level has been held to the lowest possible level that would permit adequate clearance above Second St. To reduce noise and vibration, the track ties are to be embedded in concrete which will be insulated from the remainder of the construction. The spaces in the terminal not required for passengers nor for the usual concessions are to be used as garages; provision will be made for storing more than 800 cars under cover and an equal number outside. Plans contemplate a future pedestrian connection at Fremont St. with the proposed municipal subway station and a future pedestrian subway leading to the north side of Market St.

The viaduct between the bridge and the terminal will be mainly of reinforced concrete similar to the vehicle approaches. Steel girders are being used over the streets, principally to avoid the use of falsework. All tracks will be in ballast to reduce noise as much as possible.

On the bridge itself the weight consideration made the use of ballasted track impracticable; instead, conventional open-deck construction was planned. Considerable study has been given to the material to be used for ties on the bridge and possible treatment of wood ties. Creosoted wood ties were ruled out because of the fire hazard. Fir ties treated with zinc chloride were excluded for fear their electrical conductivity would be sufficient to interfere with the signal circuits. Final decision was in favor of all-heart redwood with no preservative treatment. To provide anchorage for rail anticreepers, ties in alternate panels will be locked tightly between floor beams. Both steel and timber guard rails are to be used. A continuous skid girder is placed inside the trusses to protect both the bridge and the rolling equipment in case of derailment.

In designing the details of the trackwork across the bridge, expansion joints are necessary to provide for the longitudinal transverse and vertical movements and at the same time maintain a constant gage. At each tower of the West Bay suspension structure and at the east end of the East Bay cantilever, provision was made for the expansion

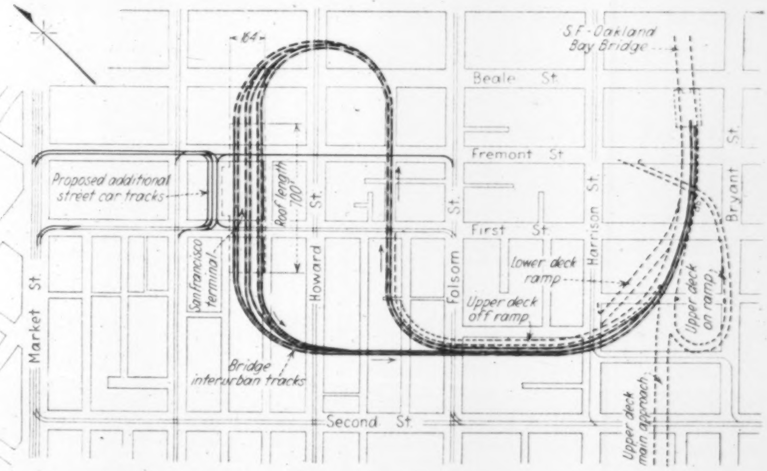


FIG. 3—LOOPS for bridge railway and surface lines meet at the San Francisco terminal.

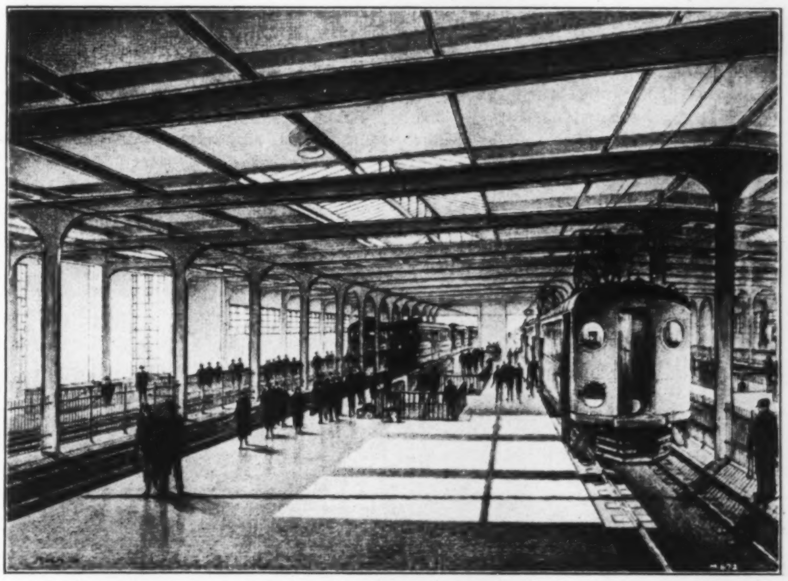


FIG. 4—INTERIOR at interurban track level in the terminal, as the artist sees it. Note girder roof supports in place of trusses. Terminal platform is below car floors because three different types of cars are used, all with requirement for street level landing elsewhere.

of the bridge, a total movement at each point of 40 in. This movement is nearly twice the amount that takes place in any other structure. The method developed uses two sets of split rail joints, so locked that not more than one-half of this movement can take place at any joint. With this lock it became possible to use joints similar to those that have been developed for other structures.

At the east end of the bridge a 42-acre yard now under construction will include storage for 123 Southern Pacific cars, 90 Key articulated units and 15 Sacramento Northern cars. Each company has two setout tracks in each direction so cars may be added to or removed from any train without interfering with schedules. Separate maintenance buildings are being built for each company and at the east end of the yard connections are being made with the existing lines of both companies. Connection with the Southern Pacific track system involves an overhead crossing of that company's mainline track. As this yard and the bridge approach divide the waterfront area of the Port of Oakland, it was necessary to include as part of the bridge project the building of an overhead structure for the port.

The power supply

Three substations, located on Rincon Hill, on the Island, and on the Key Route mole, are to be constructed by the Pacific Gas and Electric Co. Power lines built as part of the bridge railway will begin at the low voltage buses of these three substations. Conversion to 1,350v. will be made at the two end substations only; the Island substation will furnish only 625v.

The overload capacity of rectifiers (4 times momentary, 3 times for 1 minute, 2 times 30 minutes, 1½ times 2 hours) is such that large capacity is being assured. In addition, part of the load at the east end of the yard will be supplied by the Key Yerba Buena station and the Southern Pacific East Oakland station, which stations now supply power for the existing service.

The mainline overhead system will be made up of: one main messenger, hard drawn copper—500,000 c.m.; one intermediate messenger, hard drawn copper—4/0 two contact wires, 80 per cent conductivity, bronze—4/0. This combination has a conductivity equivalent to 1,000,000 c.m. Somewhat lighter combinations are used in the yard and in the terminal.

The system is sectionalized at about half-mile intervals, namely, at the terminal, the top of Rincon Hill, the center anchorage, the Island, the East Bay crossing, the center of the yard and the east end of the yard.

The third rail is 150-lb., high-conductivity steel with a copper equivalent of 2,530,000 c.m.

The proposed operation, on 3 per cent grades, of 10-car trains on a 65-sec. headway is without precedent and is feasible only with the latest developments in the art of railway signaling. Cab signals with train-control devices were adopted. The system provides for four speeds, namely, 35, 25, 17, and 11 miles per hour, and a light in the motorman's cab indicates when these speeds have been reached. The signals actuating the train-control apparatus are transmitted by coded track circuits with a 100-cycle frequency. These codes are picked up by a receiver mounted on the front axle of the train on which a governor also is mounted. When the permissible speeds are exceeded by 1 m.p.h., a warning bell rings in the cab and when the excess speed reaches 2 m.p.h., an automatic emergency brake application is made.

ESTIMATED COST OF BRIDGE RAILWAY FACILITIES

Item	Amount
San Francisco terminal	$2,300,000
San Francisco viaduct	1,000,000
Trackwork and contact rail; bridge and San Francisco section	1,000,000
Overhead and feeders, bridge and San Francisco section	320,000
tion	320,000
East Bay yard and connections	2,715,000
Signals and interlocking	1,385,000
Engineering and contingencies	910,000
Property	3,875,000
Alterations—railroad equipment	3,855,000
Interest during construction	540,000
Total	$18,000,000

All tracks in the San Francisco terminal area and all main and setout tracks in the storage yard are interlocked. For this purpose what is known as an *"N-X"* system of electric interlocking is being installed. In this system levers are dispensed with entirely; the routes are set up by the manipulation of control knobs and push buttons on a track diagram.

Equipment

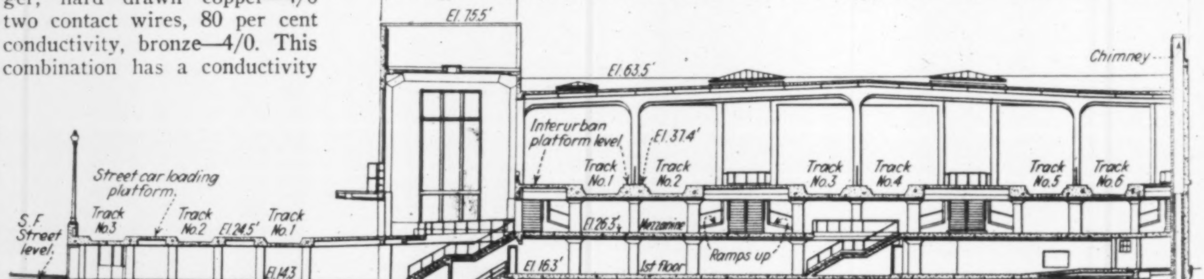
The Southern Pacific rolling stock is comparatively modern. For adaption to use on the bridge it requires only cab-signal equipment, automatic couplers, and the motorization of 12 trailers. Because the Key equipment was older and consisted largely of wooden cars, complete rebuilding was required in this case. As a result, at the start of bridge operation the Key System will have 88 articulated units of all-steel construction, each unit with seats for 124 passengers.

Financing

In financing the bridge, the Reconstruction Finance Corporation loaned $61,400,000 (*ENR,* Mar. 22, 1934, p. 376) for vehicle facilities. Of this amount $53,300,000 was used in the construction of those facilities, leaving a balance of $8,100,000. This amount, together with an additional loan of $10,000,000 authorized by the Reconstruction Finance Corporation on Dec. 18, 1934, makes up the total of $18,000,000 available for financing the construction of railway facilities on the bridge.

The railway facilities are being designed and constructed under the direction of the Department of Public Works of the State of California. Representing the interests of the three railway companies, respectively, in matters pertaining to the Bridge Railway are Earl Mayo, assistant chief engineer, Southern Pacific Co.; H. P. Bell, vice-president, Key System; and Walter Evans, electrical engineer, Sacramento Northern Ry.

FIG. 5—CROSS-SECTION through the San Francisco terminal showing different track levels and relation of surface to bridge interurban railway lines. Ballast and ties (not shown) will bring rail heads to platform levels.



Fort Peck Dam Closure Slopes Drained by Perforated Metal Pipes

PENDING the completion of the four diversion tunnels, the Fort Peck hydraulic-fill earth dam is being built in two sections, one on either side of the Missouri River. After diversion of the river, planned for this coming summer, the present channel will be filled by a closure or plug section of the dam. The present slopes of the dam that face the stream are known as the "closure slopes." Most of the water from the dredging operations flows down wooden spillways at the river ends of the core pools, one on each closure slope, but some of it drains through the fill under hydrostatic pressure.

In July, 1935, seepage from the closure slope on the left bank first became appreciable, and the slope became unstable at the toe. The fill at this time was about 30 ft. high. Experimental drains of various kinds were placed in the upstream left bank section to determine the most feasible means of stabilizing the slope. One intercepting drain consisted of 200 ft. of 8-in. perforated corrugated iron pipe laid parallel to and about 40 ft. inside the toe at a depth of 6 to 8 ft. The drain was laid on a slope of 2 per cent to the outfall, installed at mid-point and perpendicular to the line. This corrugated metal pipe was perforated for one-third of its circumference, and the pipe was set with perforations at the bottom, a position proved to be a most efficient and economical means of keeping the slope dry and stable.

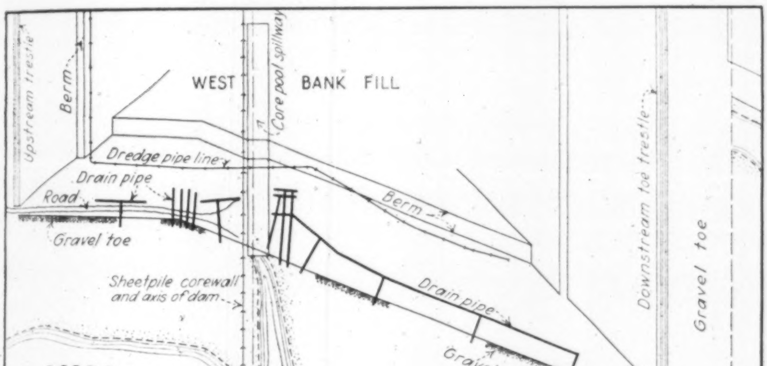

Upstream trestle
Berm
WEST
Core pool spillway
BANK FILL
Dredge pipe line
Drain pipe
Road
Berm
Gravel toe
Sheetpile corewall and axis of dam
Drain pipe
Gravel toe
Downstream toe trestle
Gravel toe
MISSOURI
RIVER
Road
Drain pipe
Berm
Dredge pipe line
Drain pipe
Road
Rock sill
Upstream toe trestle
Berm
EAST
Core pool spillway
BANK FILL
Berm
Scale, Feet
0
200
400

FIG. 1—PERFORATED PIPE SYSTEMS drain the closure slopes at Fort Peck Dam, stabilizing the sand fills that hold the core pools in place.

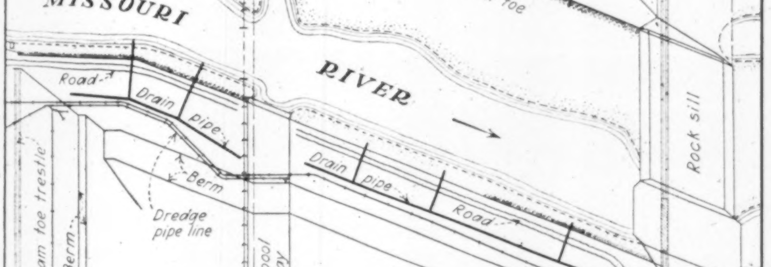

2070
2060
2050
2040
Elevation
Face of slope
Seepage line
Seepage line broke out here
8" perforated header
8" outfall
Seepage line after installation of drain pipe
Missouri River
150'
400'

FIG. 2—EFFECT of drainage system on seepage through fill slope.

Late in the 1935 dredging season perforated pipe drainage systems were laid in the right bank fills about 100 ft. inside the slopes, as shown in Fig. 1. During the following winter additional drains were installed in the left bank closure slope, downstream from the spillway. Vertical pipes were placed at the junction of the interceptor and outfall pipes to permit flushing of the outfalls if they should become clogged with silt or ice. This precaution, however, has proved unnecessary.

The seepage line in the left-bank upstream slope before and after installation of the perforated interceptor is shown in Fig. 2. A similar drawdown of the saturation line has been noted in the vicinity of other drains. The outfall pipes discharge a continuous flow.

The drainage system functioned satisfactorily all through the 1936 dredging season and no seepage has appeared at the surface of any of the slopes where drains have been installed.

Information and illustrations for this article were furnished by D. H. Henderson, of the R. Hardesty Mfg. Co., Denver, which furnished the pipe, and by the Armco Culvert Mfrs. Association.

◆

Highway Bridge Building Creates Large Steel Market

ALTHOUGH there is an increasing demand for structural steel for buildings and other similar private work, highway construction continues to afford the most important market, according to an analysis of business just completed by the American Institute of Steel Construction. The Institute expects that this market will become of greater importance in the next few years.

During 1936 the structural steel fabricating industry produced over 1,600,000 tons of fabricated structural steel. Thirty-seven per cent of the total went into bridges, railway and highway. Twenty-five per cent went into buildings—governmental, institutional and commercial. A little better than twenty-two per cent went into the erection of new industrial plants.

The effect on the structural steel market of public works, exclusive of bridge building, is small. Only about three percent of the fabricated structural steel sold in 1936 is known to have gone into engineering projects. The remainder, about thirteen per cent, constituted odd jobs, all under fifty tons each, that are difficult to classify. In that miscellaneous group are grade crossing projects, repairs and extensions to plants, etc.

Erecting 56-Ton Sheaves For Calumet River Bridge

Special equipment set-up required to raise operating sheaves 210 ft. to tops of towers of Torrence Ave. lift bridge in Chicago

FOUR of the largest and heaviest sheaves ever used in a lift bridge are required in the new Torrence Ave. crossing of the Calumet River in Chicago, which will be opened to traffic this summer. Their weight of 56 tons each and their diameter of 15½ ft. provided the contractor with an unusual erection problem, which he met by ingenious combination and revamping of his existing equipment.

The Torrence Ave. bridge is a 276-ft. lift span, weighing 1,600 tons, and lifted at each corner by 20 cables 2¼ in. in diameter and 156 ft. long. The cables pass over the sheaves at the top of the 240-ft. towers to connect with the counterweight which moves up and down inside the rectangular towers. The sheaves 5 ft. wide, are mounted on a shaft 30 in. in diameter and 9½ ft. long, which is in turn mounted on huge roller-bearing pillow blocks weighing 12 tons. The bridge provides a 200-ft. wide channel for shipping, with 21-ft. vertical clearance in closed position and 125 ft. clearance when open.

Erection of each sheave required the lifting of a 60-ton load, (consisting of the 56-ton sheave and shaft and 4 tons of lifting fittings,) a vertical distance of 210 ft., the installation of the roller bearings and the setting of the assembly in final position. After considering a number of methods, it was finally decided to use a steel stiffleg derrick, with a specially designed and reinforced 40-ft. boom, placed at the top of the tower on the top flange of the river-face girder, which was reinforced with stiffening angles under the derrick mast. The sill anchorages of the derrick were lashed to the tower legs with cables.

Since the existing steam hoists on the steel erecting derrick had neither adequate continuous lifting capacity nor drum capacity for this high and heavy lift, requiring the use of 2,700 lin. ft. of ⅞-in. cable reeved in nine parts, the contractor's 100-ton floating diesel-electric derrick was brought into service. First, the standard hoist cable was removed from the steel erecting derrick, and the special ⅞-in. cable substituted and reeved through special roller bearing blocks to the drum on the floating derrick. Then, since this drum was grooved to accommodate 1⅛-in. cable and in addition could store only about one-third of the amount of cable required, it was necessary to remodel it. This was done by welding a new drum outside of the existing drum and building up the sides of this addition to a height of 7¼ in., to hold the nine layers of cable required. Ample lifting power thus was available from the floating plant, and the other movements of the steel erecting derrick, such as swinging, lowering and raising the boom, were handled by the hoist on shore.

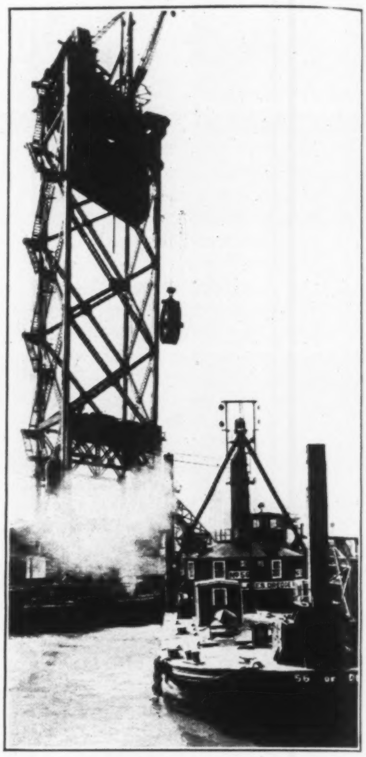


FIG. 2—RAISING A 56-TON SHEAVE onto one of the towers of the Torrence Ave. lift bridge in Chicago using a 9-part line from a hoist on the derrick boat in the foreground

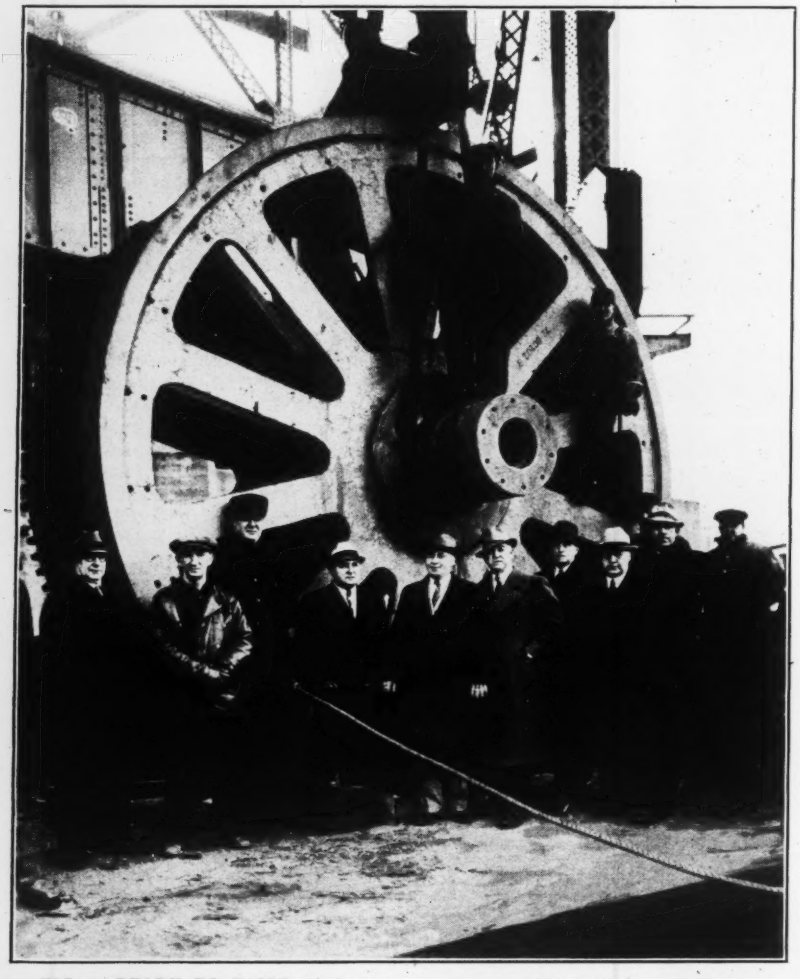


FIG. 1—READY TO RAISE the last sheave using a saddle consisting of stirrups around the shaft connecting to a lifting beam.

A special lifting saddle was designed

for handling the sheaves, consisting of two stirrups made from $1\frac{3}{4}$-in. square steel bars bent to conform to the circumference of the shaft and extending upward to a steel lifting beam placed across the top of the sheave as shown in Fig. 1. This beam was made up of two 15-in. channels between which are inserted a triangular plate 1-in. thick reinforced by two 1-in. pin plates. A $3\frac{1}{2}$-in. diameter pin was used to attach this saddle to the derrick falls.

After careful preparation and tests as to the adequacy of this equipment, the sheaves were raised into place, the lifting operations consuming about ten minutes per sheave. Each sheave was landed at the top of the tower on an I-beam grillage supported by hydraulic jacks, which permitted the removal of the lifting stirrups and the installation of the roller bearing blocks on either end of the shaft. With the bearings in place, the assembly was put in position.

The erection scheme was devised and the equipment designed by the contractor, the Great Lakes Dredge & Dock Co., Chicago.

The unusual size of these sheaves was at the root of another special problem, namely, the insertion of the shafts into the sheaves at the fabricating plant. Usually such shafts are inserted after the sheave hole has been expanded by heating. The large size of these sheaves made this impracticable, and the alternative of shrinking the shaft by cooling was adopted by the fabricator, the American Bridge Co. The cooling medium consisted of a mixture of 459 gallons of alcohol and 9,600 lb. of dry ice, which was placed in a boxlike structure 11 ft. deep into which the shaft was lowered in vertical position. A 6- to 8-hr. exposure to a 90 deg. F. below zero temperature caused a 1/64 in. shrinkage in shaft diameter. The sheave had been made in two vertical halves, and the shaft was quickly removed from the bath and lowered into one of these halves. Then the other half of the sheave was lowered over the shaft, completing the assembly in an elapsed time of about 4 minutes. In 6 hours the shaft had expanded to normal size, providing a satisfactory fit.

The Torrence Ave. bridge will cost $1,150,000, is being financed by a PWA grant and a state gas tax refund to the city. It is being built under the direction of the bureau of engineering of the Chicago department of public works. Loran D. Gayton is city engineer.

Finding Good Subgrade Materials

EMPLOYING simple apparatus, the Arizona highway department is conducting tests to develop a test measure of the stability of subgrade materials. A description of the apparatus and process with some test results are published by J. W. Powers, engineer of materials, W. G. O'Harra, chemist, and R. J. Shaw, laboratory helper, in *Arizona Highways* for March, 1937. The following description of the apparatus and testing process is taken from that paper.

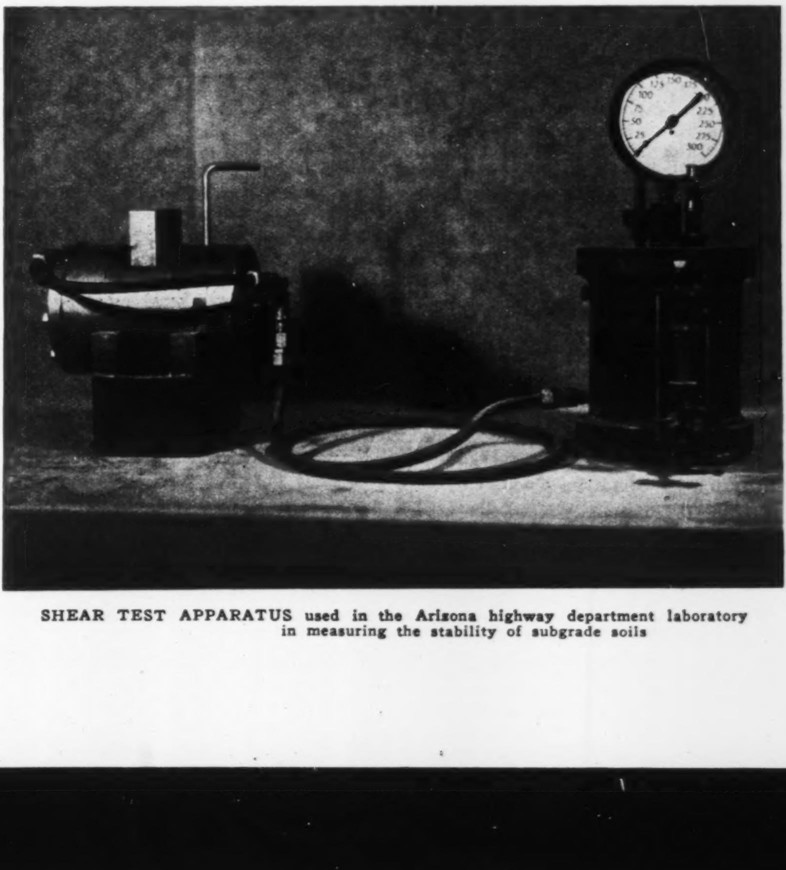
It is found in practice that highway subgrade failures occur in materials that will accumulate sufficient water under actual conditions to cause them to become plastic. The object in this method is to determine the shear strength of the material at moisture contents that are likely to occur under actual conditions.

The apparatus, is essentially the same as that used by Berry, but has been altered to allow the use of compressed air in applying the pressure normal to the shearing force. The material to be tested is first passed through a 3-mesh square sieve. Several 1,000-gr. batches are then made up, using different amounts of water varying from that necessary to produce a nearly dry mix to that necessary to produce a very wet mix. The material is placed in the cylinder in 1-in. layers, and tamped to ultimate compaction; the Hubbard-Field tamping spade having a tamping edge $\frac{1}{4}$x$\frac{15}{16}$ in. is suitable. The top of each layer is roughened before the next layer is added.

Air connections are now made to the air reservoir, the cylinder is placed in the saddle and the aparatus is placed in Hubbard-Field press. The air pressure is run up to 100 lb. per sq.in. for 1 min., then decreased to 75 lb. per sq.in., at which pressure the test is run. The load is then applied at the rate of 0.8 in. (40 turns) per minute; this rate is maintained until the gage indicates a maximum has been passed. The apparatus is then removed and cleaned, a sample of the material from the middle of the cylinder being retained for moisture determination. The test is now repeated, using the remaining batches.

A centrifuge moisture equivalent is then run on the material in the same manner as that used in the Bureau of Public Roads soil constants, but with the following variations: 25 gr. of material passing 3-mesh is used to have the C.M.E. value on the same material as is used in the shear test, thus affording a basis for direct comparison with the moisture content in the shear tests. However, in the case of materials which will almost entirely pass a 40-mesh sieve, the 5 gr., 40-mesh C. M. E. is used.

The shearing loads are plotted against the corresponding moisture contents, and the intersection of the resulting curve with the C.M.E. percentage is noted. Actual correlation between shear values and field observations of subgrade conditions have been made on about 75 materials. This is not deemed a sufficiently large number to warrant any final conclusions, but enough materials have been tested to realize the possibilities of the test.



SHEAR TEST APPARATUS used in the Arizona highway department laboratory in measuring the stability of subgrade soils

Fair-Trade-Practice Roadbuilding

Two years of code control of contracting practices in Wisconsin has met with the favor of contractors, engineers and road users

By H. G. Meigs

Deputy Commissioner, Wisconsin Trade Practice Commission, Milwaukee, Wis.

A CODE of fair trade practices has for two years governed highway contracting in Wisconsin. Opinion asked of and expressed by contractors, road officials and business interests associated with roadbuilding indicates a unanimous decision to continue trade-practice activities. It is agreed that they have brought gainful results to roadbuilders and to the public. In view of the record it is of interest to note how code practice came about and what its authority and procedure are.

How codes came

In 1933, when codes of fair trade practices were a center of interest at the national capital, the Wisconsin legislature passed the Wisconsin Recovery Act which had for its objectives the elimination of unfair methods of competition and unfair trade practices. This law was declared unconstitutional by the Wisconsin Supreme Court on the grounds of illegal delegation of power. Legislation was again sought and in 1935 the legislature passed an act, known as Chapter 110 of the Wisconsin Statutes, which undertook to meet the objections of the supreme court and to lay down legislative standards as a guide to the provisions of codes or trade-practice standards. This act was signed by the governor on June 25, 1935. Closely following enactment which vested in the governor the authority to prescribe trade-practice standards, an action was started to determine constitutionality. The Supreme Court took original jurisdiction and ruled that the power confered upon the governor to eliminate unfair methods of competition in business and unfair trade practices as provided did not constitute unconstitutional delegation of legislative power to the governor and the administrative agencies to be created by him, and the law was held valid in the respects considered.

The governor then appointed an administrator to whom he delegated certain administrative powers. Almost at once representative groups of several industries petitioned for codes to correct unfair trade practices in these industries. The governor approved codes for industries that indicated unfavorable conditions due to unfair methods of competition and unfair trade practices and these codes became effective.

The legislature did not provide funds with which to carry out the purposes of the law and necessary funds were dependent upon assessments made upon the members of the several industries under the codes. Propaganda was spread to the effect that these assessments were unconstitutional because they were in the nature of a tax and that the legislature could not delegate the power to tax. Again the supreme court was asked to take original jurisdiction in an action to determine the validity of this question; it ruled that the assessments were not taxes and were adjudged constitutional.

Highway code set up

Highway contractors were among the first of the industries to ask for code regulation and their request was approved July 23, 1935. As first set up, highway-code administration was virtually autonomous. The line of authority was later changed by an executive order issued in April, 1936. The administration of all trade practice standards (codes) is placed directly in the Wisconsin Trade Practice Commission composed of two commissioners appointed by the governor in place of the administrator. Under the provisions of this order the former code authorities become trade practice committees and the executive secretary becomes deputy commissioner. The order further provides that all assessments be paid to the state treasurer and expended on vouchers audited by the secretary of state, and handled the same as all other state funds. It is further provided that all moneys received through assessments from members of any industry, except that part for the administration of the new Trade Practice Commission, be used exclusively in administering the trade practice standards for that specific industry.

Contractors subject to code

As set up, the highway code provides that every member of the industry is subject to the provisions of the code and all highway construction projects financed wholly or in part by federal, state, or county funds, where the bid price exceeds $5,000, are subject to its provisions. The scope of the code authority and the definitions of unfair practices are presented in the accompanying tabulations. As established, the authority consists of thirteen members appointed by the governor: Seven members selected from the membership of the Associated Wisconsin Contractors, four from the members of the industry, one representing labor and one representing the public.

Cost estimates stressed

As will be seen from the schedules of authority and unfair practices, the essential operating documents governing contractors are the standard estimate summaries which they must make out for every bid. These are formidable documents and the contractors, assisted by accounting and engineering skill, devoted many days and weeks in preparing the summaries of cost for each division of the industry: Bituminous and concrete surfacing; bridges, culverts and structures; crushed rock and gravel surfacing, and grading, which, in turn, were approved by the administrator after formal hearing to which all members of the industry were invited. Besides the various items of construction cost the summaries stress general cost items as:

Overhead—The cost summaries set up a minimum percentage of overhead and contingencies in each division of the industry. This item includes telephone and telegraph, hotel and travel expenses, office supplies and expense, insurance not based on payroll, miscellaneous freight and express, interest on project fund (operating capital and borrowed funds), share of general company overhead, surety bond, state code assessment and contingencies. Aside from the item of contingencies, the general items of overhead are more or less uniform in the several divisions of the industry. The contingency item differs with the type of work involved and was arrived at by securing from contractors their experience over several years of operations.

Equipment Rental—Rental values for each piece of equipment involved in the several divisions of the industry were

UNFAIR TRADE PRACTICES

1. **To underestimate or omit the lowest reasonable cost of any item required by the standard cost estimate summary where the amount of such underestimate or omission when added to the total amount of said standard cost estimate summary, results in said total amount of the bid or proposal being below reasonable cost.**
2. **To file a bid or proposal or accept a contract below the lowest reasonable cost of the work to be performed.**
3. **To use less than the lowest reasonable cost standard established by the Wisconsin Recovery Administration in estimating lowest reasonable costs.**
4. **To use more than the highest reasonable productive capacity of listed equipment in estimating the lowest reasonable costs.**
5. **Failure to file the standard cost estimate summary with the bid or proposal.**
6. **Bid peddling, disclosure of bids where such disclosure would mislead or deceive any subcontractor or material vendor; failure to pay subcontractors, material vendors or others less than their proportionate amount of partial payments received during the course of the work; to permit the financing of a principal contractor by subcontractors or material vendors; to defame a competitor falsely; to interfere with contract of another member of the industry in the prosecution of any highway project.**

determined and set up as a daily ownership and operating cost. The basis for these values was secured from the rates established by the Associated General Contractors of America in their last published manual revised to fit the Wisconsin conditions. Again the experience of contractors was secured to arrive at conclusions. Rental values include depreciation, taxes, fire and theft insurance, interest on investment, storage, field repairs, major repairs, fuel, oil and grease. Obsolescence is not included as an item of cost.

Insurance—Included in the cost summary is a fixed minimum item of expense representing insurance. This item covers compensation, property damage, public liability, riot, contingent liability and unemployment, and unemployment insurance, the basic rates for which are established by the Wisconsin Compensation Rating and Inspection Bureau and similar organizations establishing rates in Wisconsin. This minimum rate does not give consideration to a small number of contractors who secure a credit rating because of favorable compensation insurance experience nor does it take into consideration the large number of contractors working under debits.

Assessments—An assessment of ½ per cent of the amount of each contract coming under the provisions of the code, payable within 10 days after the execution of the contract, is established. The purpose of the assessment is to defray the expense incidental to the initiation of the code, and administering and enforcing its provisions.

Authority procedure

The code authority selected an executive secretary who is in charge of the administration and enforcement of the code under its supervision and provided for an office and field personnel. This personnel includes K. G. Kurtenacker, formerly of the state highway commission of Wisconsin, and O. C. Rollman, formerly its construction engineer, who are designated as examiners.

To these men is delegated authority to examine and correct all standard cost estimate summaries. They are then returned to the contractor with a full letter of explanation indicating errors and omissions. These examiners are further authorized to protest bids, which, in their judgment, are below reasonable costs and to prosecute violations.

The code authority, through its examiners and an efficient field force of engineers, conducted studies and investigated costs of operation and the capacity of various kinds of equipment usual to the industry, made findings and fixed standards of such costs and capacities, which when approved by the administrator, became prima facie proof of the facts. These findings have been included in detailed studies and have been made available to the members of the industry and to the members of the state highway department. These studies included detailed analyses of wages and hours of work for labor and developed the fact that the minimum wage rates provided for common labor and some of the intermediate type, were not only inadequate but offered no incentive to the worker on relief to seek employment. This condition was due to low minimum wage rates, restricted hours of work and seasonability of the industry. This matter was called to the attention of the Industrial Commission of Wisconsin, the state department fixing minimum wages for highway projects, with the result that the 1937 schedule of minimum wages provided for the highway construction industry has been increased slightly in excess of 25 per cent over 1936 rates.

Capacity schedules have been provided for the several divisions of the industry based on the result of these studies, which are made a part of the standard cost estimate summary and guide the code authority and the examiners in protests and decisions.

Whenever, in the opinion of the examiners, the bid of a contractor violates the provisions of the code, his bid is protested. This protest is filed with the state highway commission within 48 hours from the time of the letting.

POWERS OF CODE AUTHORITY

1. **To enforce compliance with the code and the act.**
2. **To adopt by-laws and rules and regulations for its procedure including trial of members of the industry charged with violating the code and for review of the findings of the code authority by the administrator.**
3. **To secure from members such information and reports as are required for the administration of the code.**
4. **To incur necessary obligations and meet such obligations.**
5. **To employ attorneys, auditors, agents and employes and fix their compensation.**
6. **To submit to the administrator for his approval: (1) An itemized budget of estimated expenses and (2) an equitable basis of assessment.**
7. **To collect assessments from members.**
8. **To file with the administrator at the end of each year a statement of receipts and disbursements.**
9. **To provide facilities for arbitration.**
10. **To conduct hearings, examinations and investigations and determine violations.**
11. **To conduct studies and investigate cost of operations and capacities of various types of equipment, make findings fixing standards of such costs and capacities, subject to the administrator.**
12. **To establish minimum rates of wages for unskilled labor and certain clerical help, as maximum hours of labor and provisions for the employment of minors.**

The offending contractor is summoned to appear before the members of the code authority to defend the charges of the examiners. After a formal hearing, a complete record of which is made, the code authority determines whether or not a violation had occurred. In cases where the code authority sustains the examiners in their protests, the record of the hearing is submitted to the administrator and, if approved by him, submitted to the members of the state highway commission with recommendations that the bid be rejected.

During the life of the code, ten protests have been lodged against offending contractors and the commission has sustained the code authority in all but one case. In no case was the contract awarded to the second bidder; on the contrary, the project was readvertised.

This form of protest has developed several weaknesses and necessitated a change which has been adopted for highway construction projects to be built during 1937, as follows: Protests against violators will be filed as in the past and where convictions are secured, an injunction will be sought against the offending contractor in the circuit court. The injunctional action is provided for in Chapter 110 and enjoins the offender against further violation. The effect of securing the injunction will be to affirm the findings of the trial tribunal of the industry and subject the offender to contempt action in case of further violations and disqualification from further bidding by the state highway commission.

Appraisal of results

A summary of activities from the date of the inception of the code—July, 1935—to the end of 1936, is as follows: Bids were received on 440 projects by 394 contractors, involving $17,494,142; 2,121 proposals were submitted covering this program and standard cost estimate sheets were submitted with each proposal. Each of these 2,121 summaries was examined and corrected by the examiners.

Indications of the better conditions under which highway contracts are being prosecuted is the fact that Wisconsin has experienced only one default of a highway contract since the establishment of the code and this failure was largely due to the inability of the contractor to perform a type of work with which he was not wholly familiar.

Perhaps it is unnecessary to state that there were certain members of the industry not in sympathy with this movement and who resisted strenuously the enforcement and assessment measures that were invoked. But by continuous persistent effort, and an intensive program of education, these members were brought into line and it is gratifying to state that no formal protest has even been lodged against the enforcement of the highway construction industry code since its inception. Sentiment asked and expressed, indicates a unanimous decision to continue trade practice activities and this favorable attitude is attributed to the fact that gainful results accrue not only to the contractor but to all of his allies and the public.

Those entrusted with the enforcement of the code are given the wholehearted support of the state highway commission which, perhaps, has had much to do with its successful operation.

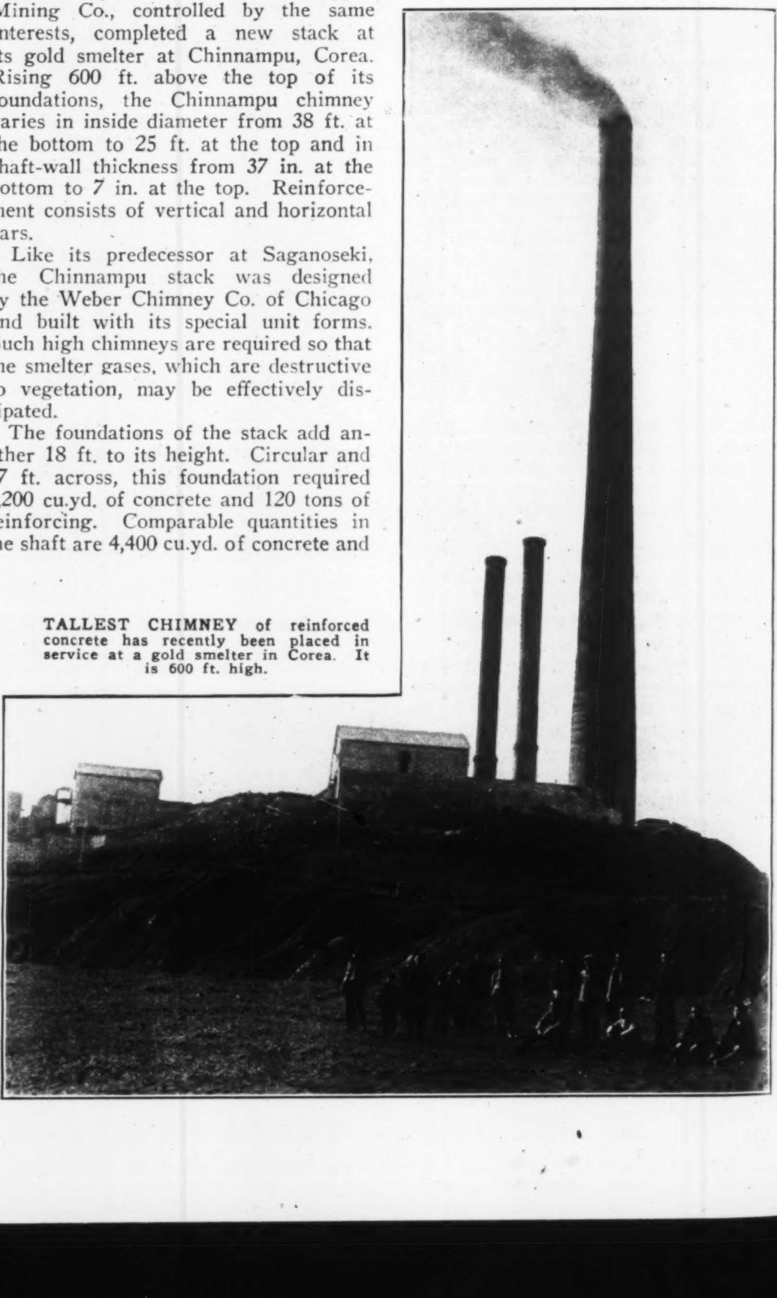
* * *

Concrete Stack Rises To Record Height of 600 Ft.

FOR TWENTY YEARS the tallest reinforced concrete chimney in the world has been the 570-ft. stack at the copper smelter of the Kuhara Mining Co. at Saganoseki, Japan. Within the past year, this height was exceeded by 30 ft. when the Nippon Mining Co., controlled by the same interests, completed a new stack at its gold smelter at Chinnampu, Corea. Rising 600 ft. above the top of its foundations, the Chinnampu chimney varies in inside diameter from 38 ft. at the bottom to 25 ft. at the top and in shaft-wall thickness from 37 in. at the bottom to 7 in. at the top. Reinforcement consists of vertical and horizontal bars.

Like its predecessor at Saganoseki, the Chinnampu stack was designed by the Weber Chimney Co. of Chicago and built with its special unit forms. Such high chimneys are required so that the smelter gases, which are destructive to vegetation, may be effectively dissipated.

The foundations of the stack add another 18 ft. to its height. Circular and 97 ft. across, this foundation required 3,200 cu.yd. of concrete and 120 tons of reinforcing. Comparable quantities in the shaft are 4,400 cu.yd. of concrete and 320 tons of steel. The shaft concrete includes that required for a 6-in. thick lining in the bottom 180 ft. of the stack. Separated from the stack walls by a 4-in. air space, this lining is reinforced by vertical and horizontal bars.



TALLEST CHIMNEY of reinforced concrete has recently been placed in service at a gold smelter in Corea. It is 600 ft. high.

Partial Flood-Control Storage Valuable in Extreme High Water

By C. I. Grimm

Head Engineer, U. S. Engineer Department
North Pacific Division
Portland, Ore.

RESERVOIRS for flood control usually have great value over a long period of years even though their capacity is not sufficient for full control of the larger floods. This point is illustrated by the accompanying diagrams which the author has found useful in comparing and studying flood control effects and flood damage. The method is described here in the thought that somewhat the same scheme may be useful to those who study the relation of flood control to flood damage on other streams.

Data in the accompanying diagrams refer to that portion of the Willamette River flood plane between Eugene and Harrisburg, Ore., one of the twelve river zones that would be benefited by a system of reservoirs now under consideration as a river improvement project. The contributing watershed above the Eugene-Harrisburg zone is 3,000 sq.mi. Of this 2,200 sq.mi., (73 per cent of the area) is above the four proposed reservoirs whose "storage regulation" effect has been considered in computing the accompanying curves. These reservoirs would have a total capacity available for flood storage of 775,000 acre-ft., which is 350 acre-ft. per sq.mi. of drainage basin and is equivalent to 6.6 in. of runoff from the tributary area, a figure comparable to that found desirable in other watersheds where storage for flood control has been used or proposed.

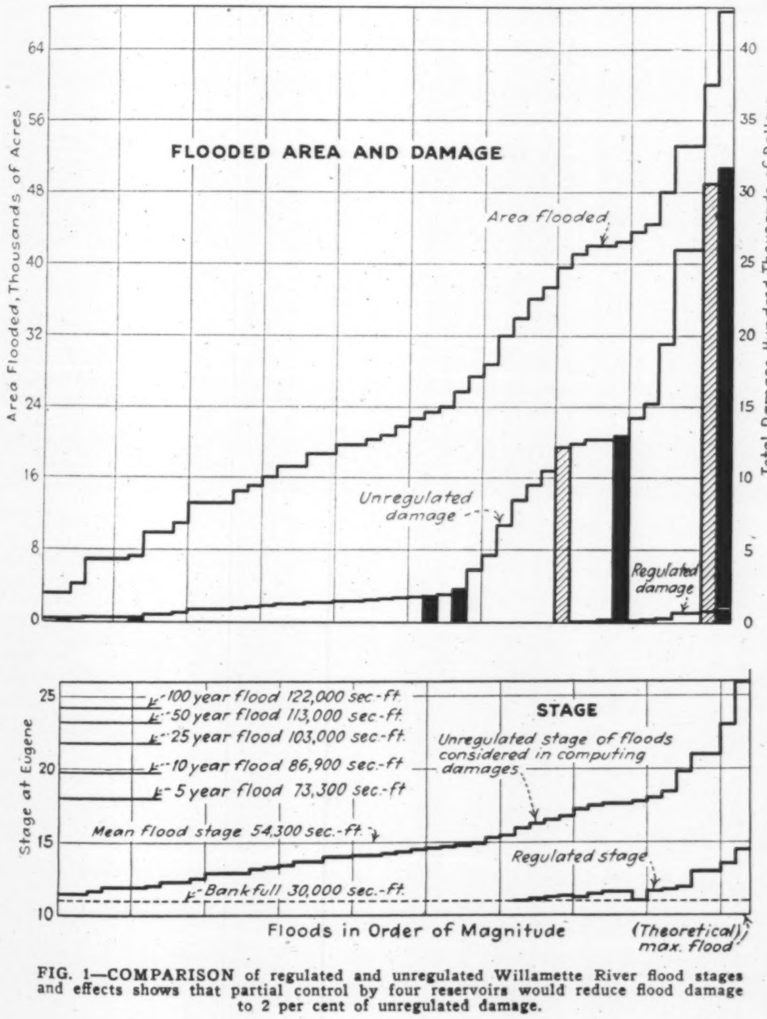


FIG. 1—COMPARISON of regulated and unregulated Willamette River flood stages and effects shows that partial control by four reservoirs would reduce flood damage to 2 per cent of unregulated damage.

During the period for which flood records are available on this portion of the Willamette the river flow has been above bankfull stage (30,000 sec.-ft.) 46 times, excluding a number of flood crests following others so closely that damage has been considered only from the preceding flood. In addition to these 46 floods, a theoretical maximum flood materially greater than any flood of record has been added to the diagram. Storage for regulatory purposes is of course effective on all floods although the diagrams show quantitatively only the effect on floods that exceed bankfull stage when regulated. It happens that in the 47 floods that exceeded the bankfull stage without regulation only 16 would have exceeded that stage with regulation. The effect of partial regulation on these larger floods is strikingly shown by the diagrams on which regulated and unregulated damage are compared.

In the 47 years from 1890 to 1936 the damage from unregulated floods, based on present conditions of development, and if one theoretical flood is included, would have totaled $26,671,700. This is an average annual damage from unregulated flow of $567,480.

If the four proposed reservoirs had been available for flood storage, however, only 11 of the floods would have caused damage; this damage would have totaled $531,200 or an average of $11,300 per year over the 47-year period. On this basis the average annual saving would be $556,180.

It is to be noted that while the proposed reservoirs will not hold the larger floods within the bank of the rather limited channel, they will greatly reduce the damaging effect. In fact, the flood storage available would be sufficient to eliminate 98 per cent of the monetary losses that otherwise would result, under present conditions of development, from the floods of record. These benefits the flood storage would obtain without the use of levees.

◆

Southwest Office Opened By Asphalt Institute

THE Asphalt Institute has established a field office in Dallas, Texas, at 613 Southwestern Life Building, which will carry on the engineering research and promotional activities of the asphalt industry in Texas, Arkansas and Oklahoma. D. G. Williamson, formerly head of the Texas State Highway Laboratories, is in charge of the Dallas office.

Within the last few months the following companies have been elected to membership in the Asphalt Institute: Anderson-Prichard Oil Corp. and the Col-Tex Refining Co., of Oklahoma City; the Cosco Oil Co. and the Cosgen Oil Corp., of Fort Worth; and the Magnolia Petroleum Co., of Dallas.

Pavement Bases and Surfaces In St. Paul, Minn.

Beginning with the subgrade, permanence of structure and precision of surface have been built into the $7,000,000 repaving program just completed

By Geo. M. Shepard

Chief Engineer,
Department of Public Works;
St. Paul, Minn.

CONSTRUCTION in St. Paul of street pavements of the types described in a previous article (*ENR*, May 13, p. 704) is exacting in both materials and workmanship. This exaction is as rigid for grading and base construction as in placing and finishing wearing surfaces. These, it is held, cannot remain smooth and stable unless the structure below has the same qualities. Nicety of construction begins with the foundation and subgrade.

Permanent subgrade

A permanent subgrade is sought by standard processes of uniform compaction and also by forestalling future subsurface construction. Utility company trenches and water and sewer trenches are flushed or tamped well before laying the concrete base. Sewer and water connections are ordered into all parcels of property whether improved or not, and old water connections are replaced in advance of laying new pavement. This cost is assessed directly to the property. Care is taken to lay conduits or piping across intersections and at other points where necessary for future extensions of lighting, police or fire-alarm system or traffic-control signals.

Where unstable material is encountered, it is removed and replaced with sand or pit-run gravel to a depth of at least 18 in. Where ground water is apt to enter under the pavement slab, as in cuts or along the bases of hills, drains with open joints are provided along the edges of the pavement, connected to the sewer system and the trenches are backfilled with gravel or pervious material. Subgrade elevation is determined either from curb or side-form elevation using a scratch templet, or from stakes set at intervals. Manhole frames and similar structures are adjusted to the final surface grade.

True bases stressed

All pavement surfaces, except of course concrete, are laid on concrete bases. The mixture for concrete base is 1 part portland cement and 7 parts aggregate including about 3 parts of fine aggregate and 4 parts of coarse aggregate of 2 in. maximum size based upon dry rodded measurement. A cubic yard of concrete in place must contain not less than 1.2 bbl. of cement per cubic yard. Where it is necessary to haul over subgrade that will be easily displaced, steel track plates are required for the batch trucks. Concrete mixer, strike board, floats, finishing belts, etc. are required in accordance with current standards, the base in all types of pavement being finished to a smooth surface.

Pavement bases exceeding 20 ft. in width, unless otherwise specified, are laid in independent longitudinal strips in separate operations. The joints between slabs are deformed steel plates to prevent displacement of the slabs and reinforcing steel is placed over all new trenches. Premolded expansion joint material ½-in. thick is placed to the full depth of the slab against the sides of radius curbs in alleys and street intersections and around all manhole tops and other permanent surface structures. The subgrade is required to be wetted thoroughly in advance of placing concrete. Expansion joints for concrete base are not required as no attempt is made to control base cracking.

At the close of a day's run, or for a temporary shutdown, the concrete is carried to a temporary header perpendicular to the road surface. A consistency of concrete which will permit finishing without excess of water is required. The concrete is compacted by a strike board or tamping bar manually operated from the opposite sides of the slab. Immediately after the final compaction, the surface is belted once, operating the belt with a combined crosswise and longitudinal motion. A wood float 12-in. wide, 3-in. thick and at least 16-ft. long with edges rounded is then operated longitudinally over the entire surface, with a combined longitudinal and transverse motion, a sufficient number of times to smooth all ridges and fill depressions. This float is operated from bridges which span the full width of the pavement. Prior to the final floating the pavement is tested with a 10-ft. straight edge and all high and low spots removed. The concrete surface is finally finished with an auxiliary belt after the water glaze has disappeared. As soon as possible the concrete is covered with burlap kept wet by sprinkling for 60 hr. Where possible, the contractor may at his option use a finishing machine for striking off and compacting the base.

To obtain a higher-strength concrete to permit surfacing or earlier opening of the base to traffic at street intersections, an addition of 0.8 bbl. of cement per cubic yard of concrete is required; the mixing time is increased from 1 min. to 2 min. and the amount of water is reduced.

Practice in the construction of concrete base for asphalt and brick pavement is founded on the premise that the final surface cannot improve greatly upon the finished surface of the base. In consequence accurate profiles are prepared for the edges of the base strips and the steel forms are set to those grades. Fig. 2 shows typical templet designs and Fig. 3 templet-use diagrams for straightaway and intersections. Steel forms for base strips and special grade stakes at intersections are checked by the engineer before concreting commences.

Asphaltic concrete surface

Class D asphaltic concrete (see p.783) as generally specified for wearing surface is an asphaltic-concrete mixture using relatively large rock, either trap rock, quartzite or granite being specified for the coarse aggregate. Trap rock has been generally used. Different mixtures are used for the wearing course and the binder course; that for the wearing course is given in the accompanying table. Generally a 60-70 penetration asphalt is used; the requirements for ductility at low temperatures are somewhat stricter than is usual in highway work.

The mineral aggregates, except filler, are dried and heated and the materials are mixed in an asphalt plant. The temperature of the asphaltic mixture when dumped from the trucks is about 325 deg. and it may be spread either by hand or by a mechanical spreader and finishing machine. Fig. 1 shows a mechanical

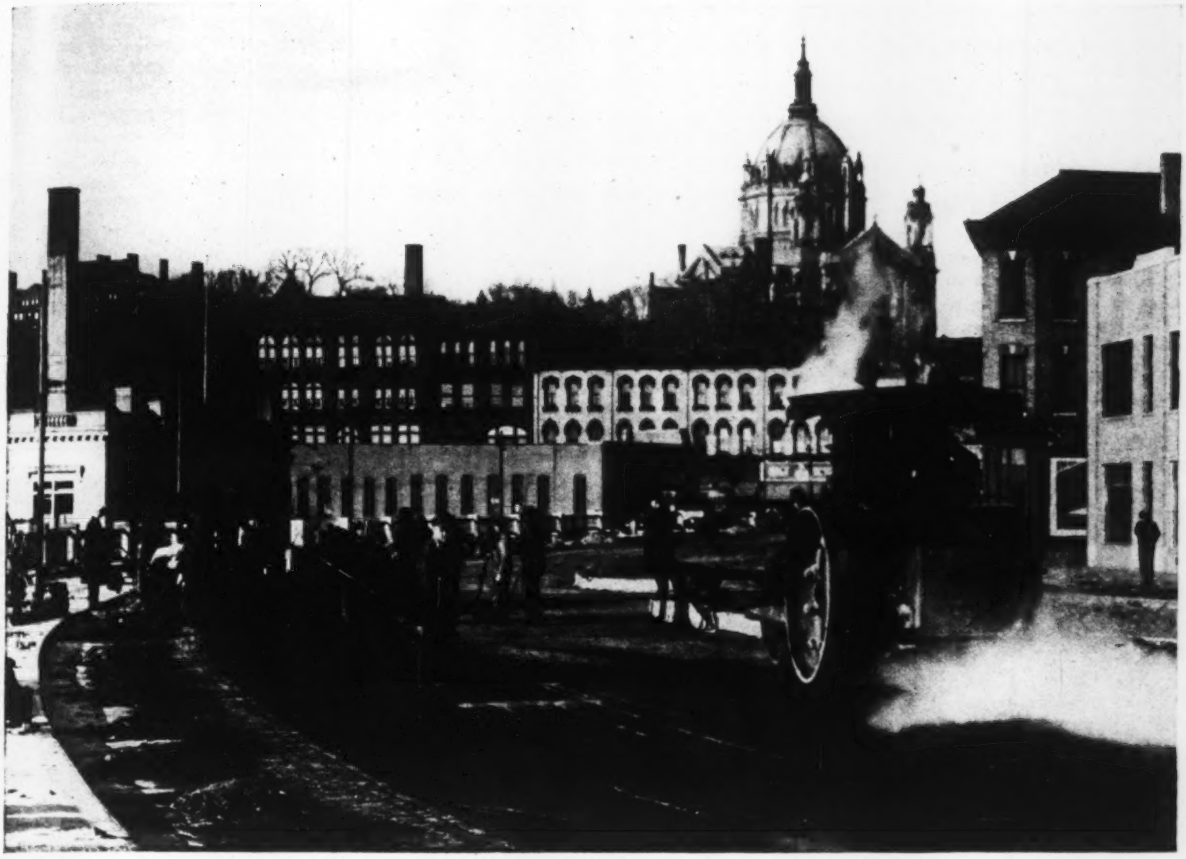


FIG. 1—PAVING KELLOG BLVD. in St. Paul during cold weather with asphaltic concrete on concrete base using a mechanical asphalt spreader.

spreader in operation under cold weather conditions. Where spread by hand the contractor may be required to use a steel plate and shovel all materials therefrom into place. Careful raking and finishing with a lute in advance of the rolling are required. Where a mechanical spreader is used, hand raking is required where necessary at the junction of the two windrows.

The first rolling is by a three-wheel roller with a weight not less than 325 lb. per inch width of tread on the rear wheels. The first roller is followed by a tandem roller with a weight of not less than 200 lb. per inch of tread. After the first rolling the surface is tested with a 10-ft. straight edge parallel to the center line of the pavement. Depressions are corrected immediately by loosening the surface and adding new mixture sufficient to bring the depressions to the true surface. After final compression, the wearing course is required to have a minimum thickness of 2 in. before the application of the seal coat; a weight of 230 lb. per sq.yd. is required.

After rolling is completed, emulsified asphalt is spread over the surface at a rate of about 2 lb. per sq.yd. The emulsified asphalt is allowed to reach the breaking point before stone chips for the final surfacing are applied; the chips are applied by hand or mechanical spreader and afterwards broomed so as to insure even distribution. The amount of stone chips required is about 10 lb. per sq.yd. Immediately after application, the chips are rolled with a tandem roller until bonded thoroughly with the asphaltic concrete. In cold weather it is advisable to apply the emulsified asphalt seal coat while the pavement surface is still warm. Dilution of emulsified asphalt is not permitted.

Where a 1½-in. binder course is required as part of the pavement, or where it is necessary in resurfacing operations to bring up the base to uniform elevation, it is composed of binder stone, sand, mineral filler and paving asphalt in the following proportions by weight.

	Typical Mix, Heavy traffic Per cent
Bitumen (soluble in CS2), 5 to 6½ per cent....................	5.0
Mineral passing 200-mesh sieve, 6 to 10 per cent....................	6.0
Mineral through 10-mesh, retained on 200 sieve, 12 to 28 per cent	26.0
Mineral through 1¼-in. screen, retained on 10-mesh sieve, 60 to 75 per cent....................	63.0
The sand or mineral through a 10-mesh and retained on a 200-mesh screen, shall have about the same grading as for wearing course.	

Limestone, brushed gravel, trap rock, quartzite or granite may be used as coarse aggregate for the binder course, limestone being the material generally furnished. The surface of the binder coarse is rolled and checked in the same manner as the wearing surface and the depressions are corrected after the first rolling.

Modern brick practice

Brick surfacing is laid on concrete base constructed as previously described and all of the present advanced practices are followed. The brick are 3-in. vertical-fiber lug brick for standard street paving and 2½-in. vertical-fiber lug brick for parking areas.

The brick are laid upon a ¾-in. cushion course of moderately dry sand mixed with No. 1 heavy road oil. About 7 per cent of road oil by weight is required; the exact amount is determined by the engineer, but enough is used for the resulting mixture to have the consistency of well-damped sand and not so much that there will be free oil. The road oil is heated before mixing and the mixing of the oil-sand cushion is generally done in an asphalt plant or a concrete mixer. The cushion course is dumped on the street in piles and is spread and prepared about 50 ft. in advance of the brick laying; it is spread evenly over the concrete and then struck off to required thickness by a strike board so that the surface of the cushion will be in all cases parallel to the specified grade and crown. After rolling, the brick is tested with a 10-ft. straight edge and irregularities are corrected by removing the brick and adjusting the cushion.

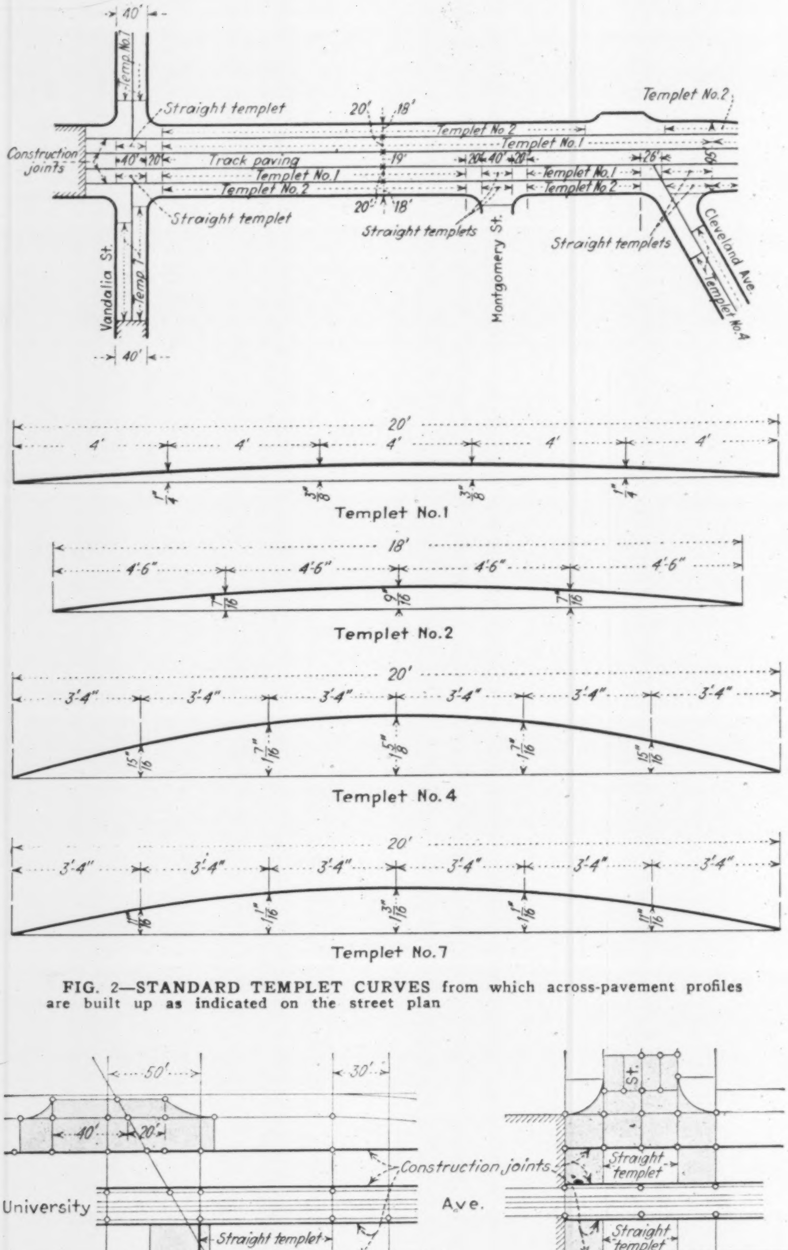

40'
Temp No.1
Straight templet
20'
18'
Templet No.2
Templet No.2
Templet No.1
Construction joints
40'
20'
Track paving
19'
20'
40'
20'
26'
Templet No.1
Templet No.1
Templet No.2
Templet No.2
20'
18'
Straight templet
Straight templets
Montgomery St.
Straight templets
Cleveland Ave.
Templet No.4
Vandalia St.
Temp 1
40'
20'
4'
4'
4'
4'
4'
1/4"
3/8"
3/8"
1/4"
Templet No.1
18'
4'-6"
4'-6"
4'-6"
4'-6"
7/16"
9/16"
7/16"
Templet No.2
20'
3'-4"
3'-4"
3'-4"
3'-4"
3'-4"
3'-4"
15/16"
1 7/16"
1 5/8"
1 7/16"
15/16"
Templet No.4
20'
3'-4"
3'-4"
3'-4"
3'-4"
3'-4"
3'-4"
11/16"
1 1/16"
1 3/16"
1 1/16"
11/16"
Templet No.7

FIG. 2—STANDARD TEMPLET CURVES from which across-pavement profiles are built up as indicated on the street plan

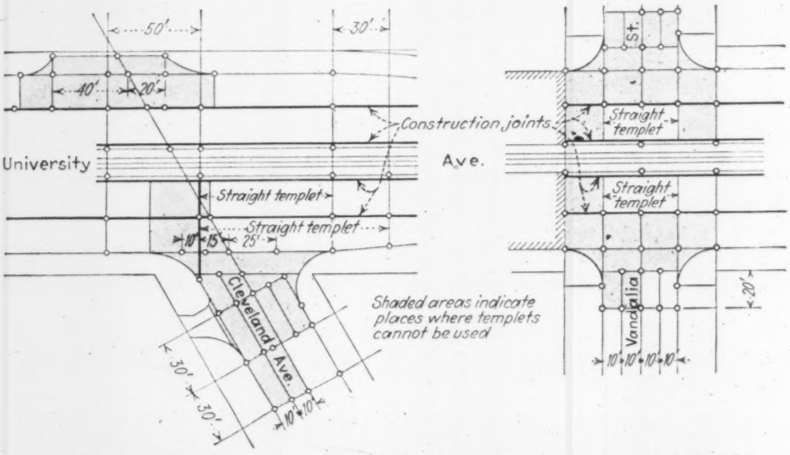

50'
30'
40'
20'
Construction joints
University
Ave.
Straight templet
Straight templet
10'
15'
25'
Cleveland Ave.
Shaded areas indicate places where templets cannot be used
30'
30'
10'
10'
St.
Straight templet
Straight templet
Vandalia
20'
10'
10'
10'
10'

FIG. 3—PLANS for street intersections show where templets cannot be used and give instead surface-finish elevations at points shown by circles

After the brick surface has been rolled, inspected and approved it is sprayed with a solution containing 35 per cent calcium chloride, 1 per cent laundry starch and 64 per cent water by weight. This solution is applied by air-pressure sprayers in the form of a fine mist, care being taken that the liquid does not penetrate the joints. The asphalt filler is then applied, the excess filler being squeegeed to fill all joints completely. Deficiencies in application are corrected by applying additional filler from pouring cans. After the filler has been applied, permitted to cool and deficient joints have been refilled, the filler remaining on the surface of the pavement is peeled off with scrapers; the re-use of such filler is permitted. A thin dressing of dry sand is then cast over the pavement and the street opened to traffic.

Standard concrete practice

As in brick surfacing the latest standard practices are followed in concrete paving. On streets, one-course concrete 7 in. thick is used with reinforcement, and 6-in. one-course concrete is used in alleys without reinforcement. The mixture is 1 part portland cement and 5 parts aggregate, about 2 parts of which are fine aggregate and 3 parts are coarse aggregate of 2 in. maximum size, based upon dry measurement. A cubic yard of set concrete in place is specified to contain not less than 1.57 bbl. of cement.

For one-course concrete a mechanical finishing machine is preferred, although the hand methods outlined under concrete base may be followed. The water content of the concrete is so regulated that an excess of mortar does not appear on the surface after compaction and so that a smooth regular finish is obtained with all coarse aggregate covered.

The reinforcement consists of bar mats or electrically welded steel fabric of equivalent area. About 5.5 bbl. of steel per square yard is used. The steel is placed 2 in. below the finished surface of the slab except for the additional trench reinforcement which is placed in the bottom of the slab.

Transverse contraction joints of deformed metal plates are installed at intervals of about 30 ft. and expansion joints 1 in. wide at intervals of 90 ft. using 1 in. premolded expansion joint material. Where the street width exceeds 20 ft., separate longitudinal strips are laid, each strip having at least a three-day set before the next strip is laid. The longitudinal joint plates do not extend through transverse joints. Unless dummy joints are used for transverse joints a protective cap for the metal is required but is removed before the concrete has fully set and then the corners are edged and the recess is filled with asphalt joint filler. A surface is required which will meet the test of a 10-ft. straight edge after the final belting. Following final belting and as soon as the consistency of the concrete will permit it is protected by burlap which is kept saturated by sprinkling for at least three days.

Pavement repairs are carried out by the construction and repair bureau of the department of public works. The city owns and operates its own paving plant including asphalt plant, storage yards,

SPECIFICATIONS FOR CLASS D ASPHALTIC CONCRETE

Paving Mixture

	PERCENTAGES		TYPICAL MIX HEAVY TRAFFIC PER CENT
	LIGHT TRAFFIC	HEAVY TRAFFIC	
Bitumen (soluble in CS2)	6 to 7	5 to 6	5.8
Passing 200-mesh	5 to 7	6 to 9	6.5
Passing ¼ in, retained on 200	24 to 40	23 to 38	34.7
Passing ¾ in. retained on ¼ in. per cent 15 to 45 Passing 1½ in. retained on ¾ in. per cent 15 to 45	50 to 65	50 to 65	53.0

Hot Sand Percentages

	LIGHT TRAFFIC		HEAVY TRAFFIC	
Through Screen	PREFERRED	LIMITS	PREFERRED	LIMITS
200	0	0 to 6	0	0 to 6
80	36	30 to 44	42	32 to 50
40	38	32 to 50	34	32 to 50
10	22	6 to 26	20	6 to 24

Hot sand refers to final hot aggregate mixture passing 10 mesh screen to weighing hopper.

Rock Chips for Surface Dressing

Passing ⅜-in. sieve per cent	100
Passing No. 10 sieve, not more than per cent	5

tanks, etc. All repairs are made by city forces. The principal repair costs are now and have been for several years past on creosoted-block pavements and on old sheet-asphalt pavements laid on a natural-cement base; some of these old asphalt streets having been in place since 1887.

The method of extensive cutting out and patching in use in former years has largely been superseded by skin patching methods, an asphaltic mix with a maximum size gravel aggregate of ⅜ in. being used. A cold mix including a small proportion of road oil is also manufactured at the plant for patching and is kept in stock piles for use during the winter and when the plant is closed down. The old asphalt streets on natural-cement base are being replaced by new paving as rapidly as funds permit. The concrete base on which creosoted-block pavements have been laid is generally in good condition, and when blocks are removed an asphaltic-concrete surfacing is placed bringing the base up to proper elevation by the use of binder.

Creosoted-block pavement, which has not been laid except on bridges since 1924, is now being given an annual application of road oil followed by light sanding; this treatment has greatly reduced both replacement and maintenance cost. A certain amount of skin patching or thin asphalt surfacing of concrete pavements has been necessary due to scaling at points where drainage conditions are poor or where salt has been carried onto the pavement by vehicles crossing street-railway-track intersections where salt has been used. The dripping of brines from commercial cars onto pavement and curbing has also proved detrimental and has in some cases required curb reconstruction.

A retread surfacing about ⅝ in. thick using stone of maximum ⅜ in. size and cutback asphalt has recently been placed on a sheet asphalt street that was badly cracked. About 0.65 gal. of cutback asphalt per square yard and 54 lb. of stone were used. The surface was cleaned and given a light coat of the cutback and the rock was dumped and spread. The balance of the cutback was applied and the material worked into place by a motor patrol and multiple blade. After rolling a seal coat of cutback and stone chips was added. The cost of this retread is about 21c. per sq.yd., and if it proves satisfactory it will unquestionably be used on a number of streets.

Irving C. Pearce is commissioner of public works of St. Paul; J. R. Johnston is superintendent of construction and repair, and E. S. Spencer is principal assistant engineer in charge of surveys and design.

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Savage Fly Outbreaks Threaten As Aftermath of Floods

An unusually large number of small but savage flies that go under various names—Buffalo gnats, turkey gnats, black flies—may be an unpleasant aftermath of the Ohio valley flood. Scarcely larger than the common vinegar fly, these midges are intensely annoying—even death dealing—to humans and livestock from Canada to Mexico.

Relatively few of the 400 species of this insect family cause trouble, according to E. C. Cushing, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. All pass their early lives in running streams, attached to logs, stones, debris, or submerged vegetation. The adults go out over the land after meals of blood. They begin to make their presence known in May in the northern states—somewhat earlier farther south.

The tiny, stinging flies are particularly pestiferous to livestock in the lower Mississippi valley. Myriads, appearing suddenly after the spring floods of the Mississippi and its tributaries, attack the heads and practically all parts of the bodies of horses, mules, and cattle, which often are killed in a few hours by the poisonous effects of the innumerable bites and the loss of blood.

Only recently have entomologists been able to offer a feasible explanation of so many of these flies at one time. It seems likely, they say, that during a flood large numbers of fly eggs are washed into back bays, cutoffs, and bayous. Unable to grow in the stagnant water left by the ebbing flood, the larvae remain in the eggs—a year if necessary—till another flood starts the water moving again. In such flowing, well-aerated water the larvae hatch and develop rapidly.

In other countries these flies sometimes bring added woe to their victims by injecting with their bite the immature stages of exceedingly small worms—filaria. The mature worms move to the skin, where they produce the lumpy lesions of the disease known as onchocerciasis. If near the eye, such lesions may cause blindness.

Unfortunately, Mr. Cushing says, no practical way to control these flies has been found. Clearing out from shallow streams the stones, logs, and debris to which eggs and larvae are attached—possible in relatively few places—will reduce the numbers. Removing livestock from river bottoms and the timely use of repellents seem the only hope for relief from these gnats. Dense smudges from burning wood, paper, or rags help repel an attack. Trappers, sportsmen, and campers in the north woods have learned—often after painful experience—to follow the example of the natives, who never venture out in daylight, during fly season, without first smearing the exposed parts of their bodies with a mixture of grease and resin from certain evergreen trees. Many different repellent mixtures are used. One of the best is 1 ounce of castor oil, 2 ounces of pennyroyal and 3 ounces of refined pine tar oil.

Stockmen keep their animals well greased during fly season to give the animals some relief. The Department recommends for this purpose an emulsion of one pound of fish oil soap, three quarts of fresh cylinder oil, one gallon of water, and one gallon of kerosene extract of pyrethrum. The water and soap are heated to near boiling and then stirred vigorously while the mixture of kerosene extract and cylinder oil is slowly poured in.

Vehicle Tunnel to be Built Under Maas River at Rotterdam

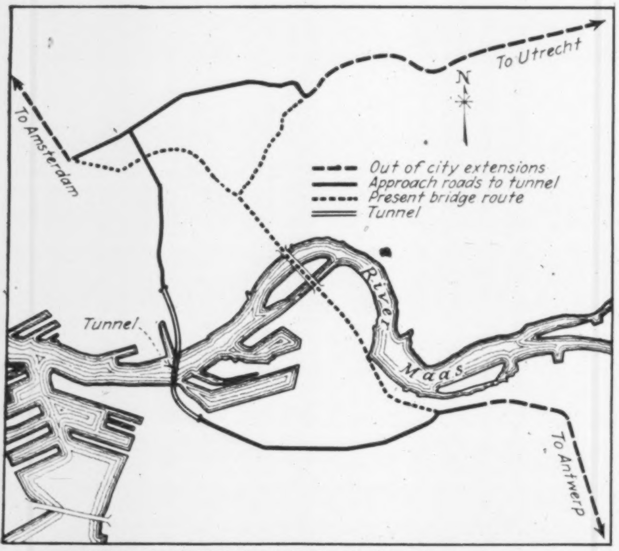
Rotterdam lets contracts for an under-river street tunnel 46 ft. wide of shore-built units sunk end to end and connected under water

TAKING a lesson from its Belgian neighbor Antwerp, the city administration of Rotterdam, Holland, with government aid, is building a vehicle tunnel under the River Maas which separates the city into two parts. Contracts for construction were signed Feb. 2, 1937, and the plans call for a tunnel 2,295 ft., long exclusive of shore approaches, to be built by sinking ten preconstructed sections in line and joining their ends under water. The tunnel is estimated to cost $7,666,400 and have a capacity of 5,200,000 vehicles a year besides bicycle and pedestrian traffic. Construction, it is expected, will be completed by January, 1941.

As shown by the accompanying map, Rotterdam, which is one of the busiest ports of Europe, has, besides a vehicle ferry, only a single bridge connection for street traffic between its two parts separated by the river and the harbor basins. The need for river crossings of greater capacity has long been felt and has now become acute, and since 1935 various plans have been canvassed including a highlevel bridge, another drawbridge, and tunnels. It was found that to accommodate shipping a high-level bridge must have a clearance of about 200 ft., which would require extraordinary approaches and at best very steep approach grades. A low-level drawbridge would not put an end to street congestion since dense river transport would require the bridge to be open much of the time.

As compared with a bridge, engineering studies showed that a tunnel could be built with a clearance dip of 50 ft. below water surface. The economies, considering the service to street transport, indicated a tunnel plan and such a plan was further supported by the fact that the work required a loan of national funds to the city and the national government had a plan to bypass through traffic around the city that called for a road and bridge about 3 mi. up the river which, it was believed, by diverting through traffic should act to keep the city project down to reasonable investment for intracity traffic service.

With a tunnel crossing virtually prescribed, the study was centered on type and size and several designs were worked out; one design was considered too expensive by the national government and another too small for the traffic. The compromise design adopted calls for a rectangular section with two traffic channels—one about 26¼ ft. wide for vehicles and one about 19⅔ ft. wide for bicycles and pedestrians. This plan considered that if traffic required it, a part of the bicycle roadway could be taken over to widen the vehicle roadway. It is reported that the wider roadway is expected to provide three traffic lanes and that the full tunnel width will provide five traffic lanes. The present capacity of 5,000,000 vehicles is based on the three-lane 26¼-ft. roadway alone and this capacity is estimated to be 2½ times the actual cross-river traffic of the year 1941.



TUNNEL AND STREET CONSTRUCTION just begun will couple up the two parts of Rotterdam, Holland, now connected by one overcrowded bridge and a ferry.

Full details of the tunnel construction plan are not available, but as stated the river portion will consist of prefabricated sections sunk in line and connected under water; the shore portions will apparently be constructed in cofferdams. The prefabricated sections are to be 229½ ft. long and ten of them are planned for the river crossing. First a braced steel plate shell (0.2756 in.) will be built on shore ways and its ends bulkheaded; then the shell will be launched and towed to the municipal drydock. Here the shell will be lined with 1.64 ft. of reinforced concrete and a piping system installed to admit water and sand for sinking. Also in drydock the lower outside half of the shell will be covered with a 1.31-ft. envelope of reinforced concrete and then the section will be refloated and the remainder of the outside encasement placd.

Previous to floating the sections into place for sinking, the tunnel emplacement will be dredged to subgrade and a bed of concrete poured onto which to sink the sections. These will be sunk by filling them with water and when in position sand will replace the water to weight them down. The ends of adjacent sections will be connected with an outside sleeve or poured concrete; a cover and backfill of sand will then be placed and tied down with stone-weighted woven-willow mats. All remaining work will be done inside when all ten sections are connected up.

Contract let

Five firms of contractors have combined to form a single company to build the tunnel at a contract price of $6,435,395, with provision for an adjustment of price if certain work is not required. Another clause provides for "a fair increase in the sum contracted if necessary on account of an increase in the prices of materials during construction." The money for construction is being advanced by the national government. Information from which this article has been prepared has been furnished by the Department of Commerce, Automotive-Aeronautics Trade Division, from reports by Homer Brett, American Consul, Rotterdam, Holland.

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Roofed Arena Without Columns Encloses 300x400-Ft. Area

A LARGE ARENA is well under way as part of the livestock exposition plant being built just outside the San Francisco city limits by Agricultural District 1-A, a California state organization. Around the oval shaped arena will be a 12,000-seat grandstand within a structure whose over-all plan dimensions are 300x400 ft. The roof will be supported on three-hinged arches carried by steel cantilever arms extending upward from the top of the concrete grandstand. The center pins in the arch will be 100 ft. above ground level. Concreting of the grandstand was completed late in April.

Forecasting Trends By Graphic Analysis

The use of simple x-y charts in the analysis of economic and engineering data, with specific application to an electric rate and water supply study

By William Wren Hay
New York, N. Y.

WITHIN the past 25 years there have been a number of interesting and valuable developments of new chart forms for graphic analysis. Notable among these are Hazen's probability chart, the ratio or semi-logarithmic chart, the hyperbolic chart and others of special or limited use, most of which are designed so that the data will lie on a straight line.

During this same period, index numbers have come into vogue for all manner of graphic and written analysis. The art of index numbers has as many aberrations as cubism in painting and nowhere are statisticians more illogical than when presenting index numbers (which are themselves ratios) on ratio charts. Similarly, the current use of biological growth (logistic) equations to forecast the output of steel ingots at some future time is equally illogical since steel ingots are not self-reproducing. Nevertheless, these new chart forms have been seized upon for the graphical portrayal of economic data of a fundamental character and frequent attempts are made to regiment our lives by such pictures.

Everywhere there is a disregard of the fundamentals of graphic analysis. Much of this may be traced to the efforts of statisticians to reduce economic data to mathematical conceptions and then to present these findings on time charts, which are infinite because time has no beginning and no ending. Besides, in many cases, time is not a factor. All of these fallacies lead to confusion. By the use of coordinate geometry, however, we may frequently derive a true mathematical expression of an otherwise obscure relationship, and whenever a functional relationship occurs we may be able to forecast tendencies with considerable certainty.

The use of x-y graphs

Economic data is almost always positive and therefore a system of rectilinear coordinates in the upper right-hand quadrant can be used to satisfy most chart requirements. Such a system contemplates the use of an independent variable (x-axis) as the measure of a dependent variable (y-axis). Time charts are usually faulty to the extent that equal and constant increments are used whereas the variations of the data are seldom if ever constant or equal. But if a truly independent variable can be selected, the relationships are frequently self-delineating and may sometimes be converted to true equations.

Engineers are sufficiently familiar with the use of ordinary x-y charts to analyze absolute data and attempt to secure straight-line relationships. Much of the value of such an analysis depends upon the selection of the independent variable. When using empirical data graphic analysis is frequently the only means of reaching conclusions and since all economic data is empirical, it may be analyzed (if at all) by graphical methods. This is best done by coordinate geometry.

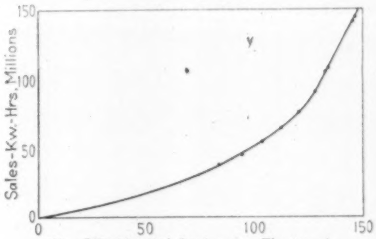


FIG. 1—**GRAPHIC ANALYSIS** of residential sales (kw.-hrs.) and revenue of the Potomac Electric Power Co.

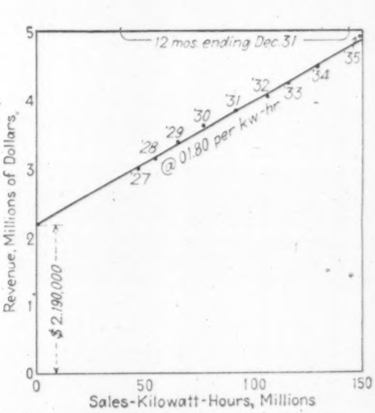


FIG. 2—**SALES** to residential consumers is a function of the number of customers.

As an illustration of the application of x-y charts to the analysis of economic data a few examples of current interest are presented. Recently, a great deal of publicity was attached to the residential consumer rates of the Potomac Electric Power Co., which furnishes electricity in Washington, D. C. Every year since 1925 this public utility has lowered its rates to domestic users. None of the published charts or calculations of unit kilowatt-hour billings revealed the real reason why this was possible nor did any of the discussions attempt to analyze the underlying conditions that enabled this company to gain approval in the halls of New Deal philosophy. An ordinary x-y chart (Fig. 1), however, shows in a clear manner that the company could well afford to reduce residential rates because it is assured of an annual return from this class of customers of about $2,200,000 and, in addition, 1.8¢ per kw.-hr. sold. In this case, the independent variable (x) is the number of kilowatt-hours sold annually and the revenues (y) received from such sales depend upon that variable.

A number of relationships exist in problems of this kind but in this particular situation it should be observed that:

1. The number of domestic customers is increasing.
2. The "minimum" amount of electricity used is increased.
3. Consequently, the base rate block is larger and, hence,
4. The base rate can be lowered and still produce a constant yearly revenue.

This analysis is quite different from the propaganda spread by political agitators about this rate. While it is true that the cost per unit kw.-hr. declined in a progressive manner, what was possible in Washington probably could not be duplicated in another community of similar size. Yet this did not prevent the protagonist of lower rates from arguing that every community could do the same.

Another step in the graphic analysis of this utility is a study of the use of current by residential customers, to determine whether it is increasing and likely to continue to increase (Fig. 2). This is a fundamental chart because the independent variable is the number of users and the dependent variable is the amount of current they are using. The points on this chart lie on a smooth "curve" which is characteristic of such charts. It shows that electric use increases slowly at first because the customers taking the service do not have many facilities; but as more appliances are acquired, and additional customers are connected, the total demand increases on a straight line. Eventually, the number of customers will cease to expand and then kw.-hr. sales will continue to grow until a saturation point is attained; when this time is reached sales will vary directly with the number of customers. Nothing could be more obvious, yet the simple graphic measurement of consumption by the consumer population is seldom applied, even by practicing engineers.

A detailed graphic analysis of the physical and financial relationships within an electric public utility is limited solely by the kind and amount of information that is available. Choice of the proper "yardstick" or *real* independent variable is not difficult if one is seeking truth. In this connection, large numbers play an important role and the whole may be more accurately measured than the component parts.

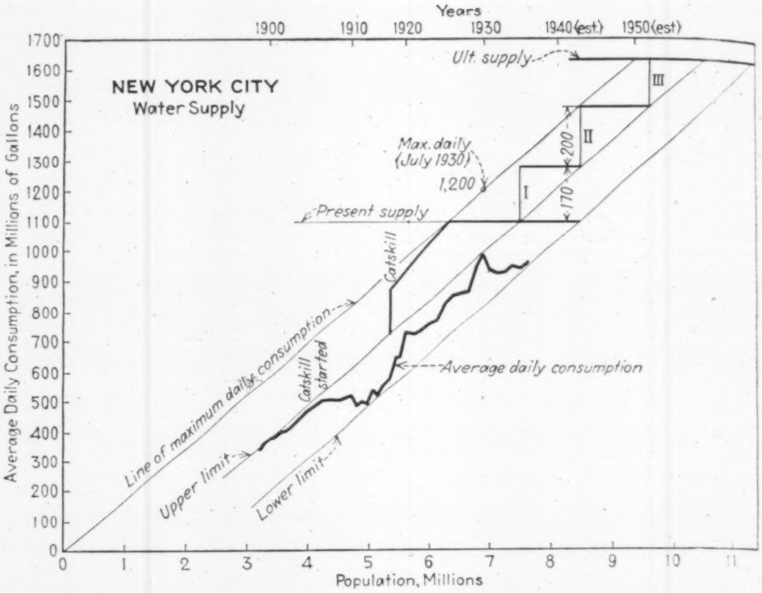


FIG. 3—WATER SUPPLY STUDY revealing the relationship between the average daily consumption and the population of New York City. The true trend (saturation line) determines the range of average daily use and supplies the limits for the construction of a step-diagram by which the need for additions to the supply can be estimated quite accurately.

Using population data

Population, while growing, is an excellent yardstick by which to measure all sorts of economic data of consumption and use. Since the future growth of population may be estimated with fair accuracy a rational forecast of future trends can usually be made. The more inelastic the demand for purposes of use or consumption, the simpler it is to show graphically what is going on and what is likely to happen in the near future. Limits, at least, are usually closely defined.

The very nature of the commodity consumed or of the articles in use greatly affects the elasticity of demand. For instance, the consumption of water is comparatively inelastic whereas the consumption of a foodstuff like oleomargarine varies a great deal from time to time due to economic conditions and other reasons. By the same token the use of electric refrigerators, which are not mobile, has increased in a more steady manner than the use of motor cars, which are not only an article of exchange but are easily dispensed with.

A comparative study of consumable commodities and of articles of use leads to some definite principles in the construction of these charts. These can be illustrated by application of graphic analysis to the matter of additional water supply for the city of New York.

New York water supply

It is a matter of experience that wherever the supply is plentiful the per capita use of water does not vary a great deal over long periods of time. In the case of New York City the data pertaining to annual water use and yearly population are readily accessible and are used in the construction of the chart shown in Fig. 3. Here the population is taken as the real measurement of the use of water. To illustrate the technique of using this type of "population chart", a detailed description of its construction and analysis is presented.

The estimated population by years is laid off on the x-axis and the average daily water consumption is plotted on the y-axis; through the point of maximum daily consumption (1930=1,200,000,000 gals.) a line of maximum daily consumption is drawn. This line is the trend of daily water consumption because it is drawn from the origin (x=o, y=o) to the saturation point. (The average daily water consumption includes that supplied by both municipal and private water systems. Private companies can deliver about 60 m.g.d.; the city system about 1,040 m.g.d.) Parallel to the trend line are drawn the lines of upper and lower limit of average daily consumption. The average daily demand for water supply will probably fall between these upper and lower limits and the yield from the reservoir system is calculated in terms of average daily delivery.

The present average daily yield of New York City's water supply system is about one billion gallons and is only sufficient for maximum (upper limit) average daily use by the present population. Increased demands would overtax the reservoirs and if drought conditions were to occur, a shortage would develop. The seriousness of the situation is accentuated by the fact that in 1939 the World's Fair will open at which time the population will be augmented at the season of the year when dry weather can be expected.

Recently work was started on additions to the New York water system, expected to add 170-m.g.d. by 1943 and 570-m.g.d. within ten or eleven years time. A step diagram has been constructed on Fig. 3 to show the effect of the new supply. This shows that by the time the first increment (I) comes into service, the present supply will not then be sufficient to take care of minimum (lower limit) average daily use, so that for some years an actual shortage of water may be expected. This conclusion is supported by the remark of a former New York City water commissioner who said last year, "At the present rate of consumption and growth, our supply will be used in full without margin of safety by 1938." Furthermore, the chart shows the first addition will only take care of the probable maximum (upper limit) demand at the time the new supply is delivered.

As a matter of analysis, the step diagram indicates clearly enough that the first increment (1) from Rondout and Neversink watersheds should have been ready by next year, that seven or eight years later the second increment (II) of 200-m.g.d. should have been ready and that the third and final increment (III) would not be needed much before the year 1950.

Lest there be any doubts regarding the accuracy of the data used in Fig. 3, a brief resume of the sources of such information is given. The figures of average daily water consumption are those of the New York City Board of Water Supply and are, presumably, metered readings of total deliveries. The population figures, to date, are those of the U. S. Dicenial Census, the interpolated years being estimates of the New York City department of health. Last year the department altered its former (and very satisfactory) method of estimating inter-censal years; on the new basis of computation it is decreed that the population of New York City may not grow faster than that of the nation. This is absurd, as anyone can determine by constructing comparative population charts of cities in relation to national population. Cities like New York, Chicago, Detroit and Los Angeles are increasing at a rate faster than the whole country, but Boston, among others, has shown no appreciable increase at all. The population estimates shown (Fig. 3) for 1940 and 1950 are the author's and are based on probability. They agree very closely with Richet's estimate for 1944 and that of the Regional Planning Association for 1950.

Other uses of charts

The use of "population" charts, which are simply x-y charts employing a true independent variable, aid in the clarification of a great many engineering-economic problems. Unfortunately, the necessary data for making such studies is widely dispersed and frequently only questionable data can be secured. Furthermore, this type of analysis is confined to commodities and articles which are actually being consumed or used by the population in question.

Despite these limitations, however, the shape of the resulting curve will give some indication of the stage of development and makes it possible to forecast growth relationships and in some cases actual decline of consumption or use.

Truss Failure Results From Using Gusset Plate as Chord Splice

By W. O. Hinckley
Whitehead & Kales Structural Steel Co.
Detroit, Mich.

BUT for the quickness of the superintendent of the building in suspecting that something was wrong and the willingness of the board of education's engineer to admit the possibility of a structural failure, there might readily have been a fatal accident when the truss joint shown in the accompanying illustrations failed.

The truss with a depth of 11 ft. and 6x6x¾-in. chord angles spanned 60 ft. across a gymnasium in a village school near Detroit and carried class rooms above. Framing into steel columns, it was encased in a plaster partition, and the first sign of failure was a crack in this partition. When the crack extended rapidly the partition was torn out, disclosing that the bottom chord was broken completely in two at the splice (Fig. 1). In spite of the complete failure of the joint, the stiffness of the concrete slab and connecting girders held the building up until cribbing could be placed.

The illustrations clearly show the faulty detail which caused the failure. By splicing the chord at the panel point, using only the gusset plate for connection, the entire stress of the bottom chord had to be transmitted through the gusset plate whose section was not more than half that of the chord members; furthermore the load was applied close to one edge of the plate. The plate failed after sixteen years of service with no excess load at the time of failure.

It is of interest to note that the original design called for chord members the full length of the truss but due to erection considerations the joint was made at the end panel point since the end panel chord took no stress.

Repairs were made by jacking the truss into place (there had been a settlement of about 7 in.), substituting a heavier gusset plate and placing a splice plate and splice angles on the bottom chord across the joint at the gusset. The corresponding joint at the other end of the truss showed no signs of failure but it was repaired in the same way.

The shoring work was done by the Detroit Underpinning Co. and the steel repair by the Whitehead & Kales Structural Steel Co.

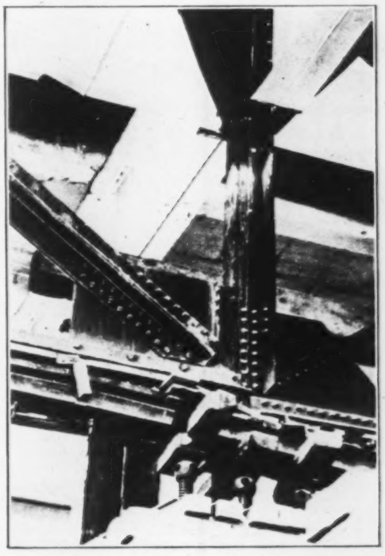
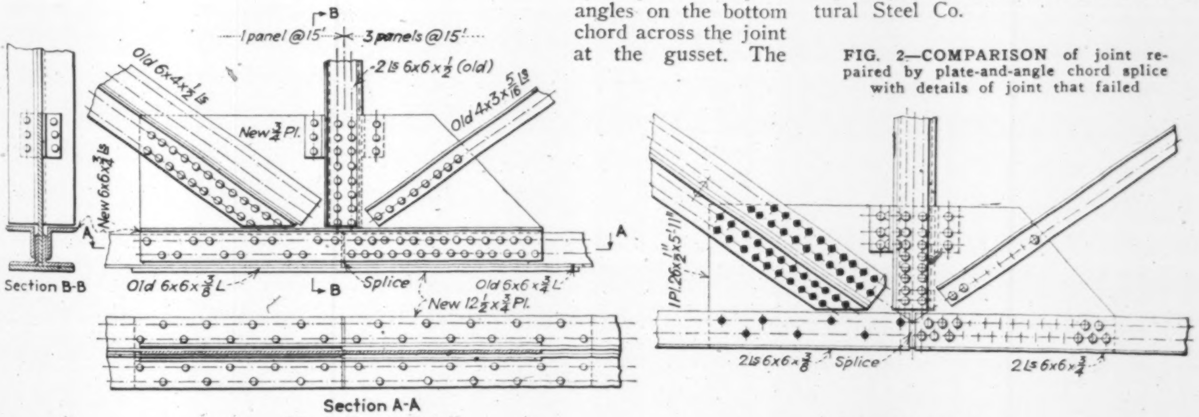


FIG. 1—FAILED TRUSS JOINT resulting from an attempt to splice the bottom chord through the gusset plate



Strengthened Detail

Incorrect Detail

FIG. 2—COMPARISON of joint repaired by plate-and-angle chord splice with details of joint that failed

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

* * *

Railroad Engineering

ELEMENTS OF RAILROAD ENGINEERING—Fifth Edition—By the late William G. Raymond, revised by H. E. Riggs and W. C. Sadler. 406 pp. Published by John Wiley & Sons, Inc., New York; Chapman & Hall, London. Price $4.25.

RAYMOND'S WELL-KNOWN TEXTBOOK on railroad engineering has been revised by two men who were associated with him before his death. The opening chapters relating to transportation are new and should give the student a clear conception of the organization of the railroads, of their regulation by the government and of their relation to other forms of transportation. Some new material has been added to the chapters dealing with track and structures, but it can hardly be said that they have been brought up to date. This is especially true of the illustrations, many of which are sketches of switches, tie plates and rail joints that now are museum pieces. Information on rail sections is out of date and nothing is said about such recent developments as GEO rail fastenings or the welding of long stretches of main-line rail into one piece. The chapters on theory of location and operation have not been affected as much by recent developments and so needed only to have the statistics revised. This has been done.

Highway Financing

BORROWING FOR HIGHWAYS—By Edna Trull. 103 pp. Published by Municipal Service Department of Dun & Bradstreet, New York. Price $2.

A BROAD HISTORICAL RECORD of the financing of American highways, beginning with the toll roads privately financed and operated by turnpike companies, is presented in this booklet. It carries through 1935 the development of state highway organization and financing. Tracing the historical record of volume of state highway borrowing and analyzing it by the different practices in the various states, it is a mine of information on per capita highway debt by states, debt service, types of highway obligations, forms of securities, provisions for retirement, term of loan. Back of these facts on past and present state highway debt are summaries of data on other highway revenue, highway taxation, trends in types of highways built, quoted forecasts of future highway requirements. Presented in a lively and interesting style, it is an excellent summary of data on state highway finances, emphasizing, as is its purpose, past and possible future borrowing.

Building Supervision

THE SUPERVISION OF CONSTRUCTION OPERATIONS—By W. W. Beach. 488 pp. Published by Charles Scribner's Sons, New York and London. Price $6.

ENGINEERING literature is rich in the theory of design and correspondingly poor in the practice of construction, chiefly because it is difficult to transform practical construction experience into words and phrases. But in this book Mr. Beach has done a remarkable job of recording his knowledge of building operations, gained through years of experience in the field. Here is as sound and practical a treatise on building construction operations as has been put into print for a long time. However, the title of the book is unfortunate as the subject matter is limited to *building* construction.

Mr. Beach set out to compile an outline of the duties of the architect's superintendent, but before he got through he had created a detailed *how* and *why* of building construction. Such a work might have become dull and prosaic reading, but by the simple expedient of following through the actual construction of a new school building at East Millville, Pa., the author has turned out an interesting and easily-read book. Every detail of the architect's duties from first negotiations with the school board to final inspection and issuing of the contractor's final certificate is covered.

Naturally, the building of the East Millville school sticks close to definite schedule and the use of definite materials. However, with considerable ingenuity the author works in discussions of materials and practices other than those encountered in this particular job. No occasion is overlooked to impress the reader with the importance of various details. For example, the necessity of subcontractor's bonds is vividly portrayed by the jam the superintendent finds himself in when the sewer trench digger attempts to get by without a bond.

Not content to complete the building, Mr. Beach goes back to point out how different the superintendent's duties would have been had the job been a cost-plus affair, where auditing, timekeeping and material purchasing would have been added to the superintendent's already overloaded cares. The author leaves nothing to the imagination. He even includes a full set of contract forms, extra-work items, certificate of payment blanks, and inspection notebooks. Also included is a full list of trade associations in the construction supply industries.

Specification writers will be enlightened, for many of the job's troubles arise over improper or vague specifications. All in all, the author has done a splendid job with the highly-complicated and detailed subject of practical building construction. Architects, designers, contractors and inspectors can learn much from this unusual book.

Hydraulics

HYDRAULICS—By Charles W. Harris. 220 pp. Published by John Wiley & Sons, Inc., New York. Price $2.75.

Reviewed by Robert E. Horton
Consulting Engineer,
Voorheesville, N. Y.

THIS TEXTBOOK is to be recommended for the simple, clear way in which each topic is presented. The preface states: "The object of this introductory textbook in hydraulics is to present the various principles in the relationship most commonly encountered in engineering practice."

The reviewer has long felt that there was a need for a textbook of elementary hydraulics that reflects the results of recent researches. The present book, howeved, departs only to a limited degree from the stereotyped hydraulic text of the nineteenth century.

In the matter of the effect of re-entrant tubes on discharge coefficient and, again, on the effect of partial suppression of orifice contraction, the author, using his own experiments, shows clearly that the older views are in error and shows clearly the reason.

In relation to thin edged weirs, a simple analytical derivation of the weir formula is given, leading directly to the numerical discharge coefficient 3.27. This gives the student a conception that hydraulic coefficients are not always experimental and empirical. In fact, they would all be capable of analytical derivation if the processes involved were fully understood. This leads to the suggestion that this, like most other hydraulic texts, is too smooth. The student is told so little of things that are not known in hydraulics that he is likely to assume that all will be smooth sailing when, out of college, he attempts to apply his knowledge. Probably one of the best ways to orient a student in this respect is to give him a clear conception of the historic background of each important formula or principle. This the author has done in an admirable manner in most cases.

In connection with weirs, however, the author has confused two independent series of experiments at the Cornell Hydraulic Laboratory, crediting both series to Rafter (p. 63). The facts are as follows: The first series in 1899 (not 1898) was carried out for the U. S. Deep Waterways Commission under the direction of George W. Rafter. The second series, in 1903, was carried out for the U. S. Geological Survey under the direction of the reviewer. Gardner S. Williams was in charge of the laboratory and handled the instrumentation. The reviewer was an assitant in connection with the first series of experiments, made all of the reductions of both series and published the results in Water Supply Paper No. 200.

Much attention is given in this book to relatively minor head losses, etc., ordinarily not of great importance in hydraulic practice, while other matters arising frequently and of great importance receive little or no consideration, such as the flow through Tainter gates and the flow over various forms of weir crests. Flow in open channels is treated in terms of the obsolete Chezy formula. Diagrams for coefficients applicable in this formula as derived from the Kutter and Bazin formula are, however, given. The statement is made that: "For large natural streams the Kutter formula is still used in standard practice" and that the Manning formula "should be classed with the mechanical means of solving Kutter's formula." These statements would have been true in 1890, at the time Manning's formula was published, but they are wide of the truth at the present time in view of the extended and ample use and verification of the Manning formula experimentally and the fact that it has been shown by Strickler and others to conform with dimensional requirements when written in the form

$$v = \frac{1.486}{n d^{1/3}} d \sqrt{S}$$

It has also been shown that Manning's n has a definite physical meaning in terms of dimensions of rugosities. The reviewer feels that it is most unfortunate to continue teaching students in hydraulics on the basis of the Chezy and Kutter formulas because they will certainly be required to unlearn much of what they have been taught.

All considered, the scope of the book is unusually complete for an elementary text. In presenting criticisms of this work the reviewer realizes that there may be wide divergence of opinion as between a practicing hydraulic engineer and the author of a college textbook as to what should be included in the book. Nevertheless the reveiwer feels that authors of textbooks could often profit by giving more careful consideration to the viewpoint of practicing engineers who have gone through the often painful experience of re-educating college and university graduates in order to make them serviceable in engineering practice.

This particular book falls little short of a high degree of excellence except with regard to the sins of omission that have been cited in this review. It is hoped that these matters may be corrected in later editions.

Miscellaneous Notes on Booklets and Reprints

CAN INTERSTATE COMPACTS SUCCEED? The use and limitation of interstate agreements. Public Policy Pamphlet No. 22, University of Chicago Press. Price, 25c.

THE USE OF AN ELBOW IN A PIPE LINE for determining the rate of flow in the pipe. Bulletin 289, Engineering Experiment Station, University of Illinois, Urbana, Ill. Price, 40c.

A REVIEW OF RAILWAY OPERATIONS IN 1936. Special series No. 65, Association of American Railroads, Bureau of Railway Economics, Washington, D. C. Free.

A READING AND STUDY PROGRAM FOR MUNICIPAL FINANCE OFFICERS. Published by the Municipal Finance Officers Association, 850 East 58th St., Chicago. Price, 35c.

SPECIFICATIONS FOR THE CONSTRUCTION and maintenance of jointly used wood pole lines. Publication No. E3, Edison Electric Institute, New York, N. Y. Price 50c. to members and $1.50 to non-members in U. S. A.

MOSQUITO CONTROL ENGINEERING: A reprint of a series of articles published in *Engineering News-Record*. Available from Engineering News-Record, 330 W. 42nd St., New York, N. Y. Price, $1, less in quantities.

COLORADO RIVER AQUEDUCT: Third edition, prepared by the Metropolitan Water District of Southern California, Los Angeles, Calif. A comprehensive account of progress to date with numerous pictures and engineering drawings. Price not stated.

SEWAGE TREATMENT STUDIES, two papers on observations on the digestion of a sewage sludge over a wide range of temperatures and the oxygen demand of mixtures of activated sludge in sewage, have been reprinted from the *Sewage Works Journal*, January, 1937, and issued as a Harvard Engineering School publication. Copies are available at 25c. each; address Prof. Gordon M. Fair, Harvard University, Cambridge, Mass.

A GLOSSARY OF HOUSING TERMS. Central Housing Committee, North Interior Building, Washington, D. C. No price given.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

MUNICIPAL AND RURAL SANITATION—By Victor M. Ehlers and Ernest W. Steel. 441 pp. Published by McGraw-Hill Book Company, New York and London. Price $4.00.

ENGINEERING ASPECTS OF PROPERTY DAMAGE PREVENTION IN OPEN-CUT CONSTRUCTION—By H. Edgar Beaven and others. 62 pp. Published by the American Mutual Liability Insurance Company, Boston, Mass. Obtainable upon inquiry.

REINFORCED CONCRETE CONSTRUCTION—VOL. I—FUNDAMENTAL PRINCIPLES—Fourth Edition—By George A. Hool, revised by Harry E. Pulver. 441 pp. Published by McGraw-Hill Book Company, New York and London. Price $4.00.

HIGHWAY RESEARCH BOARD — Proceedings sixteenth annual meeting — Edited by R. W. Crum, director. 390 pp. Published by the Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, D. C.

HEADWATERS—CONTROL AND USE—Papers presented at the Upstream Engineering Conference, 1936. 261 pp. Published by Soil Conservation Service and Forest Service, United States Department of Agriculture, with the cooperation of Rural Electrification Administration. Obtainable from the Superintendent of Documents, Washington, D. C. Price 60c.

REPORT ON FLOOD CONDITIONS IN THE GENESEE RIVER—By Edwin A. Fisher. 246 pp. Published by the City Manager, Rochester, New York.

THEORY OF MODERN STEEL STRUCTURES — VOL. II — INDETERMINATE — By Linton E. Grinter. 270 pp. Published by The Macmillan Company, New York. Price $4.50.

MODERN BUILDING—ITS NATURE, PROBLEMS AND FORMS—By Walter Curt Behrendt. 230 pp. Published by Harcourt, Brace and Company, New York. Price $3.00.

THE MUNICIPAL YEAR BOOK—1937—Edited by Clarence E. Ridley and Orin F. Nolting. 594 pp. Published by The International City Managers' Association, Chicago, Ill.

CENSUS OF BUSINESS—1935—CONSTRUCTION INDUSTRY: VOL. III—Types of Construction, Comparisons between 1929 and 1935, and Miscellaneous Data. 179 pp. Published in a limited edition by the Philadelphia Branch, U. S. Bureau of Census.

DRAINAGE BASIN PROBLEMS AND PROGRAMS—December 1936—Report of the National Resources Committee. 540 pp. Obtainable from the Superintendent of Documents, Washington, D. C. Price $1.50 (paper cover).

ELECTRIC POWER IN THE U.S.S.R.—Prepared by members of the Academy of Sciences, in the Soviet Union. 496 pp. Published by International Publishers, New York. Price $3.00.

FLUID MECHANICS—By Russell A. Dodge and Milton J. Thompson. 471 pp. Published by McGraw-Hill Book Company, New York and London. Price $4.00.

ENGINEERING NEWS-RECORD
Volume 118, No. 21 Copyright, 1937, by McGraw-Hill Publishing Company, Inc.
EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, N. A. Bowers, W. G. Bowman, W. W. DeBerard, C. S. Hill, H. W. Richardson. E. J. Cleary
Editorial offices at 330 West 42nd Street, New York
May 27, 1937

Freeways by Law

THE first specific legislation for freeways can, it appears, be claimed by Rhode Island. It is rather striking. As defined by the law a freeway is a way designed for through traffic over which abutters have "no easement of light, air or access" by reason of the fact that their property abuts upon such way. The act is to come under the administration of the state highway department with the same authority that it has in other state highway activities. Its essential value is that it empowers the department to protect its through travel. In no state has this been completely practicable heretofore; no sooner have through roads been built than sales stands, inns, service stations and other businesses have sprung up to hinder through traffic with turnouts, parking and across-road travel. It may be a question whether commerce and residence should be denied this right, but it is absolutely certain that through roadbuilding becomes an absurdity if it is not denied. There are hundreds of examples in proof. But if there are to be through-traffic freeways there must also be service roads for abutting business and residence; the perfect freeway is not everywhere a single road.

Necessary Protection

IN THE HEYDAY OF LAND DEVELOPMENT by irrigation under the federal reclamation system it was common practice to victimize settlers by selling them bare desert land for the price of a going irrigated farm. This practice laid a curse on reclamation and caused most of the troubles that have surrounded its thirty-five years of existence. In actual figures: On one project, which with irrigation and improvements produces enough to make the farms worth $150 to $200 per acre, the irrigation works cost something more than $100 per acre and the necessary improvements and buildings cost $50 to $75 in addition; the land by itself was worthless, yet scores of farm tracts were sold at prices of $150 to $250 per acre without payment for the irrigation works or for buildings, clearing, leveling and fencing. It was real-estate piracy of aggravated kind, made possible by the interest-free instalment system of paying for reclamation works. Somewhat similar profiteering laid a curse on private irrigation development also, and it is largely responsible for the sorry financial history and the evil repute of irrigation enterprises. But federal reclamation suffered most; intended to be a highly beneficent development undertaking, it became a system that placed an almost impossible burden on the settlers whom it was intended to help. Everyone who has observed this result will welcome the news that Congress last week enacted a law to curb land profiteering in the Columbia Basin irrigation project in the state of Washington by limiting the price paid for any land to its appraised dry-land value and by controlling the amount of land that may be held by one individual or family. Such protection is particularly necessary in irrigation that must be subsidized in any event, as is true of Columbia Basin with its vast scheme for impounding the water of the Columbia River behind Grand Coulee Dam and pumping it to a reservoir formed in the coulee itself. The new law by no means removes all the difficulties that threaten the success of this extraordinary million-acre scheme, but it removes one hazard that would have been certain to wreck its future.

Those WPA Signs

NOT SINCE THE LIBERTY LOAN DAYS of two decades ago has the country undergone such a placarding as the WPA is now giving it. From highway patching jobs to major bridges and buildings the red white and blue posters proclaim simply and with deadly monotony "USA—Work Program—WPA." There can be no quarrel with the WPA's desire for credit for a job well done, and it has done many jobs effectively. But these signs are too reminiscent of the days when every municipal improvement afforded an excuse for a huge sign stating that this or that sewage plant or bridge is only made possible by the sterling work of Mayor John J. Doe. In simple terms, the signs are pure political propaganda. This is not a serious charge perhaps, but it is important that the true nature of the signs be recognized. It is also important to call attention to the fact that WPA signs are being used on projects with which the WPA has only the most tenuous connection—grade crossing eliminations and replacement of large bridges destroyed in floods, for example. Both of these types of project are administered by the U. S. Bureau of Public Roads, are designed by the various state highway departments and railroad companies, and are built by contract. Congress merely told the WPA to devote certain of its funds to these specific purposes, and having transferred the funds WPA's responsibility ceases. They are not WPA projects, and it is as logical to have a U. S. Treasury Department sign on them as it is to have a WPA sign. In its zeal to make a good showing, the WPA is claiming more credit than is its due. And if it must use signs on its own legitimate work, why not have them describe briefly the nature of the improvement that is being carried forward with WPA forces? Then the public as well as the WPA would be served.

Tunnel Flexibility

SINCE THE CONSTRUCTION of the vehicle tunnel at Detroit by sinking shore-built sections on a dredged bed and connecting them under water no major river crossing in America has been made in this manner. Meanwhile European engineers returned to this method—long ago used in building a Seine River tunnel—in the bold work of a few years ago at Antwerp, and as is noted on a preceding page they are beginning a crossing of the River Maas at Rotterdam. As an engineering design the Rotterdam tunnel possesses a striking feature in its ratio of width to height, about three to one. With a width of 50 ft. and a length of 300 ft. the shallow boxes of steel plate encased in concrete present an interesting problem in sinking and seating to preserve cross-section and profile levels. Details of the box design to ensure stiffness are not at hand. As floating vessels the prefabricated sections of tunnel offer no particular risk of bending and warping but landing the sections on the river bottom should call for something rather accurate in bed preparation. Engineers everywhere will watch with interest the procedure followed.

Unionization of Engineers

On opposite sides of the continent the matter of unionization of engineers has come strongly to the fore, though the reasons for its sudden prominence are only remotely related. In Seattle particularly, and less intensely throughout the whole state of Washington, a strong drive to sign up all salaried engineers with the American Federation of Labor has put squarely up to several hundred engineers the question of whether they will or will not join a union. In New York, where some industries are being organized into vertical unions by the Committee for Industrial Organization—the C.I.O.—the demand for a closed shop has become so insistent that engineers find themselves practically compelled to join the union. The situation in New York is thus characterized by an engineering executive of one company: "We don't believe that our engineers have to join the union, but as the Wagner Act is now interpreted we believe that we must tell all men below the executive grade that they are expected to join. If they don't, we can't force them to."

In the abstract, the large majority of engineers view engineering as a profession, something above trades and unions; yet many of these same engineers find that their pay in most instances is below that of men in the skilled trades and they see evidence around them of still better pay being obtained by these skilled trades through concerted action. Today the abstract question for many engineers has taken on concrete form; they find themselves forced to decide whether to hold to the principle that their work is professional activity rather than manual labor, and stay out of labor unions in the hope that their employers voluntarily will increase their pay, or else to forget principle and join a union which holds out enticing hope of better pay.

The issue now put up to many engineers has another unfavorable though less evident aspect. It would seem to lead to a definite cleavage between the engineer who is an employer and the employed engineer below the executive grade. In fact, if the unionization movement goes forward on a large scale, it may lead to the elimination from engineering of the subprofessional group (as to type of work rather than as to qualification), putting them into a class of skilled technicians along with carpenters and shovel operators. The definite segregation of these men as labor union members will help to widen the gap between engineer employer and employee and inevitably will speed the day when many of them will find themselves completely out of the engineer group.

May it not be that the way to avoid unionization can be found in much more aggressive activity in matters relating to salaries and working conditions on the part of state societies of professional engineers? The New York State Society of Professional Engineers, for example, in cooperation with some of the other local engineering organizations, has done much in an informal way in recent years to improve the position of engineers, especially those employed by relief agencies. It could do much more without any major change in its organization. Through county chapters such a state society can keep in close touch with local conditions.

The present drive toward unionization of engineers finds its source in the Wagner Labor Relations Act. The unions are making the most of that act's implied grant of exclusive bargaining power on pay and working conditions to majority groups, thus depriving the minority or the individual worker of any such right. That the courts ultimately will restore to minority groups the rights that now appear to have been taken away appears certain. When that day comes, the small groups of engineers can be heard through representatives of their own choosing and will not need to lose themselves in a larger group whose representatives have little knowledge of their peculiar problems.

There is then no present need for engineers to join labor unions, either voluntarily or unwillingly, under the false impression that they have no alternative. If existing organizations of engineers keep abreast of their responsibilities, there never will be need for unionization in the engineering profession.

Unfamiliar Roads

"Unfamiliar with the road" said a recent news item in telling of a fatal automobile crackup. Was this another case of the human failure that is so freely blamed in nearly every accident? Undoubtedly; but it is not certain that it was the driver's failure. It may have been the roadbuilder's failure.

The roll of accidents of this type means just one thing—that some roads are not safe except to travelers who have gone over them enough to know their dangerous spots. In spite of warning signs it remains true that roads do have danger spots, not merely a few but a great many. Everybody knows that this is, so, and everybody knows also that not all of the dangerous spots are adequately signaled and guarded. The regrettable part of the matter is that road planners and roadbuilders sometimes do not seem to be aware of fatal hazards created by their work, and that more often they do not make a determined effort to avoid creating hazards when the road is built or to cure them afterward.

It should never be forgotten that the road vehicle, lacking the mechanical guidance that keeps the railway train on its track, relies wholly on clear and unequivocal information furnished to the vehicle operator about the roadway ahead. If at every point the driver is not advised about coming turns, crossings, obstacles and sudden dangers, the road is not safe for him—neither at 30 nor at 60 m.p.h. An unannounced turn, seen only with difficulty, is too often accompanied by sudden disappearance of a ridable shoulder, or by equally sudden appearance of a wall or a culvert rail dead ahead; and if such hazards result in accident the road authorities are more to blame than the driver. True, the traffic officer may report "Ran off the road", or "Excessive speed", but we are tardily beginning to learn that statistics based on such reports do not make sense.

Let us have adequate guide and warning signs, and let us make the warnings sensible, not a large "Stop" that does not mean stop. Then let us proceed actively to remove the unnecessary danger spots. Even the simple and impressive warnings that once were common in a few states, white crosses to mark accident spots, could be made of service; fitted with reflectors they would not leave the night traveler unwarned, though of little service in showing the course of the road. At any rate, with ample guides and warnings as a beginning we might look forward to a time when the roadbuilder's work would make even an unfamiliar road safe to the wayfarer.

CURRENT NEWS

Gila Water Project Dropped by House

Interior department bill passes House carrying $9,500,000 for Bureau of Reclamation

Completing action on the last of the regular departmental appropriation bills, the House of Representatives on May 20 voted $123,700,000 for the expenses of the Department of the Interior during the fiscal year ending June 30, 1938. This amount is approximately $2,000,000 more than during the current fiscal year, $3,000,000 above the Budget estimate, and exceeds the recommendation of the House appropriations committee by nearly $8,000,000.

Vocational education was responsible for the largest increase. Federal aid to states for this purpose, under the provisions of several existing laws, was raised from $7,241,500, as recommended by the appropriations committee, to $14,483,000.

A total of $9,416,600 was appropriated from the Reclamation fund for work on various projects of that Bureau, but an item of $1,250,000 for the Gila project in Arizona was stricken out after a bitter debate, indicating that Arizona is going to have difficulty in procuring new reclamation projects until she ratifies the Colorado River Compact. The committee recommendations were adopted in regard to other reclamation projects.

Another substantial increase was granted to the National Park Service for the Blue Ridge and Natchez Trace Parkways, for which the combined appropriation was raised from $3,000,000 to $5,000,000, of which not over $500,000 would be available for the Natchez Trace. The House thus reversed the economy efforts of its committee and allowed the full amount approved in the Budget.

◆

Bill Against Land Speculation Passed by Congress

Both Houses of Congress have acted favorably on a bill to prevent speculation in irrigable lands adjacent to the Grand Coulee project on the Columbia River, and early approval by President Roosevelt is expected. The bill (*ENR*, April 22, 1937, p. 607) would restrict the holdings of any one person in the project area to 40 acres, with husband and wife being counted as separate persons. It is further provided that if any irrigated land in the project be sold at a value greater than its appraised value as arid land, half of the excess be paid to the government.

The law specifically exempts lands now being cultivated in existing reclamation projects, even though additional water may be requested from Grand Coulee. It also provides that owners may procure exemption from its provisions by filing a legal renunciation of all rights to receive water.

New Pittsburgh Water Supply Proposed by Mayor

Mayor Scully of Pittsburgh has announced plans for a new $70,400,000 water supply system for Pittsburgh and the neighboring territory. The announcement was made as the Pennsylvania legislature began consideration of a number of bills designed to promote the financing of the project and to eliminate certain legal obstacles.

The mayor's plan would abandon the nearby rivers as the source of water supply and draw on Upper French Creek, 140 miles north of Pittsburgh, Sugar Creek, Sandy Creek, Spring Creek, Wolf Creek and the northern branch of Slippery Rock Creek. The program would involve construction of a series of fifteen earth dams with concrete core walls ranging from 18 to 150 ft. in height, a distributing reservoir and filtration plant and a long 17-ft. aqueduct, as well as numerous changes in the water distribution system at Pittsburgh and much relocation of highway and utility lines.

The bills now before the legislature would establish a public corporation to be known as the Pittsburgh Water Conservation District with authority to issue bonds and to accept money from PWA.

◆

Summer Conference on Planning To Be Held at Harvard

The School of Architecture of the Massachusetts Institute of Technology and the Graduate School of Design of Harvard University are jointly inaugurating a summer conference on city and regional planning which, it is hoped, will be the first of an annual series of such conferences. The conference will be held at Harvard University starting June 14, 1937.

The conference is planned to meet the needs of men now working with planning agencies, students of planning, members of local planning boards, and teachers of civics and related subjects.

The conference will be divided into morning and afternoon sessions. The morning sessions will be devoted to a series of lectures and discussions and the afternoon sessions will be devoted to supervised design and research projects selected to meet special needs of individual students. The lecture and discussion courses will be divided into three groups. The first, given June 14–25, will be devoted to basic planning principles; the second, presented June 28–July 3, will cover planning technique; and a third course in a final week, July 5–10, will be devoted to planning administration.

A fee of $75 will be charged for the entire conference and fees of $40, $25, and $25 respectively will be charged to those who wish to take one or more of the group courses. Information on the courses may be obtained from Prof. Frederick J. Adams, 491 Boylston St., Boston, Mass.

Wage and Hour Laws Called For

President asks Congress for flexible legislation setting minimum wages and maximum hours

President Roosevelt on May 24 transmitted to Congress his long-expected message dealing with labor conditions in industry. Phrased in general terms, the message urged the passage, during the present session, of legislation that would bar from interstate commerce products produced under "unfair" labor conditions, including unduly long hours, low wages, and the use of child labor.

No definite standards were specified by the President, who pointed out that "most fair labor standards, as a practical matter, require some differentiation between different industries and localities. . . . Allowing for a few exceptional trades and permitting longer hours on the payment of time and a half for overtime, it should not be difficult to define a general maximum working week. . . . It should also be possible to put some floor below which the wage ought not to fall. There should be no difficulty in ruling out the products of the labor of children. . . . And there should also be little dispute when it comes to ruling out of the interstate market products of employers who deny to their workers the right of self-organization and collective bargaining. . . ."

"With the establishment of these rudimentary standards as a base we must seek to build up, through appropriate administrative machinery, minimum wage standards of fairness and reasonableness, industry by industry, having due regard to local and geographical diversities."

Immediately after the reading of the message bills to carry its recommendations into effect were introduced by Senator Black and Representative Connery. These proposed the setting up of a five-man commission to determine basic hour and wage standards, make what adjustments might prove necessary and act as a general continuing administrative agency in enforcing its rulings. The bills also forbid interstate commerce in goods produced in violation of the Board's requirements, by children under 16 years of age, and by firms employing strikebreakers or sponsoring industrial espionage.

◆

California Engineers Form Organization

The National Society of Professional Engineers has announced the organization of the California Society of Professional Engineers, the third such state society to be organized this year.

The officers of the new society are: Fred A. Roemer, president; Frank R. Weeks, vice president; Harry G. Petersen, secretary; Edward J. Wiener, treasurer.

THE GOLDEN GATE BRIDGE being cleaned up for the opening celebration which is being held on May 27.

Fiesta Celebrates Opening Of Golden Gate Bridge

Completion of the Golden Gate Bridge at San Francisco is being celebrated with a typically western "Fiesta" on May 27. The bridge will be open to pedestrians from 6 a.m. to 6 p.m. on that day, and no vehicles will be allowed, so that those who desire may have the thrill of walking across this historic strait on a roadway more than 200 ft. above water level. A cavalcade including costumed representatives from Canada and Mexico, covered wagons of pioneer days and a highly colorful ceremonial have been widely advertised. Regular vehicle toll service will begin May 28.

History of the project

The Golden Gate bridge project dates from 1917 when M. M. O'Shaughnessy, then city engineer, invited Joseph B. Strauss to work on the unprecedented problem of bridging the mile-wide arm of the sea. Two years later Mr. Strauss submitted a design; six years were occupied in getting an enabling act passed, and six more years were consumed in getting a bridge and highway district organized, financed and into effective operation. Consulting engineers selected were O. H. Ammann, Leon S. Moisseiff and Charles Derleth, Jr. Mr. Strauss has been chief engineer of the project since its inception; Clifford M. Paine is his associate, and Russell G. Cone has been resident engineer since construction began. The contractors responsible for the principal elements of the project are: Pacific Bridge Co., Portland, Ore., main piers; Barrett & Hilp, San Francisco, anchorages; Bethlehem Steel Corp., Bethlehem, Pa., steel superstructure; and John A. Roebling's Sons Co., Trenton, N. J., cables.

The main span is 4,200 ft., the approach spans are each 1,125 ft. long, and the steel towers are 746 ft. high and 90 ft. wide. A 60-ft. roadway and two 11-ft. sidewalks are provided on the deck. Two cables are used, each 36½ in. in diameter. Except for an eleven-month delay occasioned by difficulties on the south main pier, construction has been rapid and on schedule.

The total cost of the bridge is reported as within the bond issue of $35,000,000 of which $8,000,000 was allowed for interest during construction, financing and other incidental expenses.

◆

PWA Makes Seven Grants

The Public Works Administration has announced presidential approval of seven grants totaling $356,000 and a loan of $44,000. The actual amounts of these grants are conditional upon the amount of relief labor used by the sponsors, the grants actually made amounting to 115 per cent of the amount paid to certified relief labor at the site of construction up to the assigned amount of the grant.

Largest of the allotment was a grant of $187,000 to San Gabriel Valley in Los Angeles County, Calif., for a storm water spillway estimated to cost $594,000. Six smaller grants covered school and housing construction, park improvements, a gas distribution system and a bridge. All of these six allotments were for amounts less than $30,000.

Boulder Power Rate Revision Asked

Proposed amendment to Bonneville power bill would permit change in charge for Boulder power

Members of the California and Nevada congressional delegations on May 21 requested the House committee on rivers and harbors to add to the pending bill for the disposition of Bonneville power a rider permitting the revision of existing contracts for the sale of energy from Boulder Dam.

The proposed amendment would reduce the interest rate charged by the federal government on Boulder indebtedness from 4 per cent to 3 per cent, in order to bring the rate closer to the actual cost of money, and would relieve the power contractors of interest and amortization charges on the $25,000,000 charged to flood control until after other features had been paid for. It would also permit each of the states of Arizona and Nevada to accept a fixed annual payment of $300,000 in place of the present 18¾ per cent of the potential surplus over amortization and interest charges. This substitution would be at the option of the legislatures of each state. Charges now imposed for falling water would be reduced to compensate for the reductions thus effected, but not to an extent that would impair payments to Arizona, Nevada, or the Colorado River development fund.

Senator Key Pitman of Nevada, spokesman for the delegation, stated that the terms of the proposed amendment had been approved by contractors for over 90 per cent of Boulder power, as well as by representatives of California and Nevada, and that the terms are acceptable to the state of Arizona. The other states in the Colorado River basin were not represented at the hearing. Senator Pitman urged that the matter be incorporated in the Bonneville bill, not because of any connection between the two projects, but because the legislative session is such that a new and separate bill dealing only with the Boulder situation would have little chance of enactment this session.

The text of the amendment was prepared by Nathan Margold, solicitor for the Department of the Interior, who stressed the fact that until the measure had received the approval of the Budget Bureau, his department could not take a position either of approval or disapproval.

◆

New Law for Tenement Repairs In New York City

Governor Lehman of New York on May 18 signed a bill authorizing the city of New York to issue ten year assessment bonds, the proceeds from which will be used to make repairs to old law tenements to bring them into conformity with the provisions of the multiple dwelling law. The cost of such repairs will be charged to the owners of the building and will constitute a prior lien on the buildings.

At the same time the Governor vetoed a bill which would have permitted the use of sprinkler systems in stairs and hallways of old law tenements as a substitute for the installation of fire retarding walls as provided in the multiple dwelling law.

Price-Fixing Curbed On Hydrants

Federal Trade Commission orders valve and hydrant group to stop restraining competition

The Federal Trade Commission has issued an order directing 33 companies, organized as the Water Works Valve and Hydrant Group of the Valve and Fittings Institute of New York City, to desist from combining to fix and maintain uniform prices in the interstate sale of water gate valves, hydrants, fittings and similar products used for water supply systems. All but one of the respondent companies are members of the Water Works Valve and Hydrant Group.

Charges admitted

In the course of the investigation, begun by the commission last November, the respondents filed answers in which they contended that all of the material facts alleged in the commission's complaint against them "might be deemed to be admitted, but not within the intent and meaning of any law of the United States other than the Federal Trade Commission Act." The commission's order prohibits the respondents from engaging in the following practices in the furtherance of any price fixing combinations:

Agreeing to fix and maintain uniform delivered prices for their products and fixing uniform discounts in the sale of such products; agreeing to divide the United States into zones in which they fix and maintain by agreement the uniform prices; agreeing to fix uniform delivered prices at which jobbers and distributors should resell the respondent companies' products, and refusing by agreement amongst themselves to continue selling to jobbers and distributors who have not resold at the prices so fixed.

The commission found that the practices of the respondents constituted unfair methods of competition in violation of Section 5 of the Federal Trade Commission act and have a dangerous tendency to hinder and prevent price competitions; have increased prices; and have created a monoply in the sale and resale of the products in interstate commerce.

Companies involved

The companies against whom the order is directed are the Rundle Spence Manufacturing Co. of Milwaukee, not a member of the Water Works Valve and Hydrant Group, and the following members of the group:

American Foundry & Manufacturing Co., St. Louis; The Bourbon Copper & Brass Works, Cincinnati; Cambridge, Machine & Tool Co. Cambridge, Mass.; The Chapman Valve Manufacturing Co., Indian Orchard, Mass.; Columbian Iron Works, Chattanooga, Tenn.; The Crane Co., Chicago; The Darling Valve & Manufacturing Co., Williamsport, Pa.; The Eddy Valve Manufacturing Co., Troy, N. Y.; The Fairbanks Co., New York; The Filer & Stowell Co., Milwaukee, Wis.; Iowa Valve Co., Oskaloosa, Iowa; Jenkins Bros., Bridgeport, Conn.; The Johnson City Foundry & Machine Co., Inc., Johnson City, Tenn.; The Kennedy Valve Manufacturing Co., Elmira, N. Y.; The Ludlow Valve Manufacturing Co., Troy, N. Y.; M. & H. Valve & Fittings Co.; Anniston, Ala.; Manistee Iron Works Co., Manistee, Mich.

The Michigan Valve & Foundry Co., Detroit; Ohio Injector Co., Wadsworth, O.; Pacific States Cast Iron Pipe Co., Provo, Utah; The Reading-Pratt & Cady Co., Bridgeport, Conn.; The Rensselaer Valve Co., Troy, N. Y.; The Rich Manufacturing Co., Los Angeles; A. P. Smith Manufacturing Co., East Orange, N. J.; South Park Foundry & Machine Co., St. Paul, Minn.; Traverse City Iron Works, Traverse City, Mich.; Walworth Co., New York; Waterous Co., St. Paul, Minn.; Western Gas Construction Co., Ft. Wayne, Ind.; R. D. Wood Co., Philadelphia; East Jordan Iron Works, East Jordan, Mich., and Pittsburgh Valve Foundry & Construction Co., Pittsburgh.

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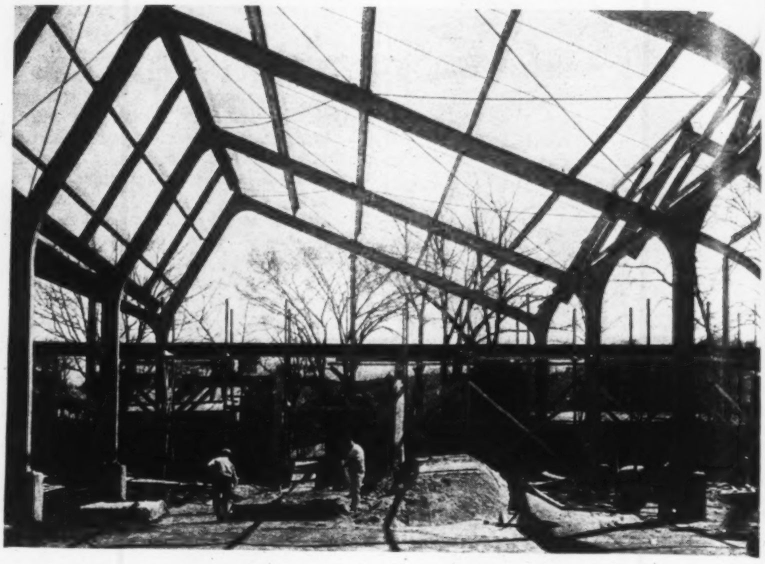

NEW PLANT EMPLOYS RIGID SAW-TOOTH FRAME

THE FIRST industrial plant to employ the new welded rigid frame saw-tooth design recently developed by the Austin Co., industrial engineers and builders, (*ENR*, Dec. 17, 1936, p. 880), is nearing completion at Meriden, Conn. for the International Silver Co.

The new structure will obtain 100 per cent availability of space from floor to roof by the elimination of all cross members and trusses. Clearance ranging from 14 ft. at the top of the columns to 27 ft. at the peak of each saw-tooth is obtained by welded roof members which span ten 40-ft. production aisles. This will allow for maximum flexibility of operation throughout the plant, which is to be devoted to stamping and buffing.

Consolidation of Mapping Recommended in Report

The Brookings Institute, which is making a special report on the executive agencies of government for Senator Byrd's committee on governmental reorganization, has recommended in a recent report to that committee that all basic mapping activities of the government be centralized in the Geological Survey and the Coast and Geodetic Survey.

Land surveys

The report points out that there are now only two agencies making basic control surveys and maps of land areas, the geological survey and the Mississippi River Commission of the Corps of Engineers. Most other government agencies making maps take their basic data from the maps prepared by these agencies. Quoting the opinion of the Science Advisory Board that the maps prepared by the Mississippi River Commission are less satisfactory than those prepared by the geological survey, the Brookings report recommends that the topographical mapping work of the Mississippi River Commission be transferred to the Geological Survey and all primary base maps of land areas be made by that organization. It is pointed out that although the Mississippi River Commission requires special information not ordinarily included in the geological survey maps, there is no reason why that organization should not follow the procedure of the Tennessee Valley Authority in requesting this additional information from the Geological Survey rather than make its own surveys.

Marine mapping

The Brookings Committee finds that hydrographic mapping is now divided among several agencies. The Coast and Geodetic Survey maps the coastal waters of the United States and the tributary streams as far as the head of navigation. The Lake Survey of the Corps of engineers maps the American waters of the Great Lakes and the connecting streams as well as the upper Hudson River and the New York barge canal. The hydrographic office of the Navy publishes charts of waters in foreign countries mostly compiled from charts made by foreign governments. The Brookings Institute feels that substantial economies would be achieved and the use of the maps made more convenient by centralization of all these activities under the Coast and Geodetic Survey, to which should be transferred these duties of the lake survey and the hydrographic office.

Arbitrator Upheld By Court

Pennsylvania court holds decision of arbitrator on extra work on Pittsburgh bridge is binding

The Pennsylvania Supreme Court, in a decision handed down May 17, held that the decision of an arbitrator as to payment for extra work is binding when provision for arbitration of such claims is incorporated in the contract.

The case arose out of the construction of a stone faced concrete arch highway bridge on Henry Ave. over Wissahickon Creek in the city of Philadelphia. A contract between the city and Francis A. Canuso and Sons, the contractor, provided that the work was to be done under the general direction of the director of public works of the city of Philadelphia, whose decision "on any questions arising in connection with the performance of the contract shall be binding and conclusive upon the parties."

In the course of the construction, falsework for the support of the arches yielded. Considerable work was required to reinforce the weakened structure. The falsework had been designed by a fabricating company employed by the contractor, and the design had been checked and modified by consulting engineers employed by the city.

The director of public works instituted an investigation into the accident, at the close of which he stated that it was his opinion that there was no liability on the part of the contractor in that the error was chargeable to the engineers who had approved the plans and who were the city's agents.

The case was carried by both parties to the Supreme Court. That court threw out the contention of the city that the award of the arbitrator was not binding and the further contention that no formal notice of hearing had been given to the city by the arbitrator. In this connection it was pointed out that informality of procedure is an intrinsic element in the practice of arbitration.

Stating that "an arbitrator is the final judge of both law and facts," and that "from a valid award there is no appeal to the court," the court held that the award was valid and conclusive upon the city.

The contractor was awarded the full amount plus interest from the date of the arbitrator's original decision.

Burnt Bridge Replaced In Four Days

The New York, New Haven & Hartford Railroad completed one of the quickest bridge-rebuilding jobs to be accomplished in New England when it reopened train service May 21 on its main line bridge over the Lieutenant River between Saybrook and New London, Conn. The bridge had been destroyed by fire on May 17, requiring the rerouting of 40 passenger trains and 30 freight trains while reconstruction was in progress.

Reconstruction of the bridge, a timber trestle, required placing of 200 70-ft. piles.

Westergaard Is Graduate Dean Of Engineering at Harvard

Harald M. Westergaard will become dean of the Harvard Graduate School of Engineering in September, it was announced recently. Professor Westergaard was appointed Gordon McKay, professor of civil engineering at Harvard last September, coming to that institution from the University of Illinois where he had taught since 1916.

Professor Westergaard is a widely recognized authority on reinforced concrete; he is a member of the American Concrete Institute and holds the Watson medal of the Institute, which he received in 1921. He was awarded the J. J. R. Croes medal of the A.S.C.E. in 1935.

A native of Denmark, Professor Westergaard graduated in 1911 from the Royal College of Engineering in Copenhagen, received his doctorate in 1916 from the University of Illinois, and a second doctorate in 1925 from the Technische Hochschule, Munich, Germany.

After working in concrete design with several Danish and British firms, Professor Westergaard came to this country in 1914 to do graduate work at the University of Illinois, and in 1916 he became instructor in theoretical and applied mechanics at that institution; he became associate professor in 1924.

In addition to his teaching work, Professor Westergaard has acted as consultant for many government and private agencies. He was a concrete engineer in the concrete ship department of the Emergency Fleet Corporation during the war; investigated flat slabs for the Bureau of Standards; served as special analyst for four years for the U. S. Bureau of Public Roads; and acted as adviser for the U. S. Bureau of Reclamation during the construction of Boulder Dam.

SOCIETY CALENDAR

AMERICAN WATER WORKS ASSOCIATION, annual convention, Buffalo, N. Y., June 7-12.

WATER WORKS MANUFACTURERS ASSOCIATION, annual meeting, Buffalo, N. Y., June 8.

ENGINEERING INSTITUTE OF CANADA, semi-centennial celebration, Montreal and Ottawa, Canada, week of June 15.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer convention, Milwaukee, Wis., June 21-25.

AMERICAN SOCIETY OF ENGINEERS, annual meeting, Urbana, Ill., June 21-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Cambridge, Mass., June 28-July 2.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, New York City, June 28–July 2.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, spring meeting, Utica, N. Y., June 3-5.

PENNSYLVANIA SEWAGE WORKS, Annual conference, State College, Pa., June 21-23.

LICENSE EXAMINATIONS

IOWA: Examinations for professional engineers June 8 and 9, and examinations for surveyors June 10 in the Senate Chamber at the State House, Des Moines, Iowa.

MICHIGAN: Examinations for architects at the University of Detroit and examinations for engineers and surveyors at the University of Detroit, the Michigan State College, the Michigan College of Mines, and at Ironwood, June 21-23. Information may be obtained from the Michigan State Board of Examiners, 306 Transportation Building, Detroit.

Road Bureau Appoints Safety Advisors

Committee of highway engineers will advise Bureau of Public Roads on highway safety

A committee of twelve highway engineers has been formed to work with the Bureau of Public Roads in developing standards of highway design for maximum traffic safety. The committee will meet from time to time with officials of the Bureau of Public Roads to consider such matters as road surface widths, maximum grades and curves, design of multi-lane highways, protection of grade crossings, and other problems.

Formation of this committee follows the procedure employed some years ago in formulating standards for designation of highways and highway signs. At that time a committee of State Highway officials was appointed by the Secretary of Agriculture and worked with the Bureau of Public Roads to develop the plan of U. S. numbered highways and standard highway signs now in use.

Membership of committee

Thomas H. MacDonald, Chief of the Bureau of Public Roads, will act as chairman of the committee.

All of the men appointed to the safety committee are state highway officials and members of the American Association of State Highway Officials. They are:

C. H. Purcell, State Highway Engineer, California; Ernst Lieberman, Chief Highway Engineer, State Department of Public Works and Buildings, Illinois; Fred Kellam, Design Engineer, State Highway Commission, Indiana; Hugh Barnes, Chief of Highway Planning, State Highway Commission, Kansas; G. H. Delano, Chief Engineer, State Department of Public Works, Massachusetts; O. L. Kipp, Construction Engineer, State Department of Highways, Minnesota; Murray D. Van Wagoner, State Highway Commissioner, Michigan; Harold W. Giffin, Engineer of Surveys and Plans, State Highway Department, New Jersey; R. H. Baldock, State Highway Engineer, Oregon; P. M. Tebbs, Assistant Chief Engineer, State Department of Highways, Pennsylvania; Gibb Gilchrist, State Highway Engineer, Texas; and C. S. Mullen, Chief Engineer, State Department of Highways, Richmond, Virginia.

Detroit Society Receives Second Gift

A second gift of $500,000 has been made by the Rackham Fund to the Rackham Engineering Foundation, trustees for the Engineering Society of Detroit. The purpose of the gift is to provide a fund for the purchase of a site and the construction of a building as a permanent headquarters for the engineering society. It is intended that the entire sum will be spent for this purpose.

The Engineering Foundation was incorporated last June and received at that time an endowment fund of $500,000, the net income of which is being paid to the Engineering Society of Detroit, also organized about that time.

Engineers Consider Union Issue

New York State Society of Professional Engineers asked to take stand on engineer unionization

The New York State Society of Professional Engineers, assembled in New York on May 22 for its tenth annual meeting, found itself faced with the issue of what attitude it should take toward the unionization of engineers. The issue was raised by men employed by public utilities in New York, utilities in which vertical unions are being organized by the C.I.O. For reasons that are not evident, all engineers below the executive grade in some of these organizations have been told by their employers that they should join the union of company employees. Those who are opposed to joining such unions appealed to the society for help in their dilemma.

What attitude the society will take on the matter was not determined as no formal resolution bearing on it was presented by the resolutions committee.

Federal operations

The society went on record as urging the employment of licensed engineers for engineering positions on all federal operations in states having engineer license laws. By a very close vote, the society also adopted a resolution urging the liquidation of WPA and the substitution of the PWA for most of the work now being carried on by the WPA. Another resolution that was adopted called for early completion of the basic network of controls for the U. S. Coast and Geodetic Survey in New York State, in order to facilitate the completion of up-to-date maps of the state.

The subject of reclassification of civil service employees in New York City was brought up for action by the convention, but John C. Riedel, retiring president, stated that there was no need for further action as the board of directors already had made the necessary provision for the society to be represented in the reclassification that is to be undertaken in the near future.

Recognition of engineers

Frederick Stuart Greene, superintendent, New York State Department of Public Works, speaking to the 800 engineers at the luncheon meeting, called for more aggressive action on the part of the society to obtain better recognition and more adequate compensation for engineers. Col. Greene said that engineers were the poorest paid profession, not excepting clergymen, as far as dollar values go, but that in satisfaction of accomplishment they were the best paid profession. He specially urged the New York State Society to concern itself with the economic advancement of engineers, stating that the American Society of Civil Engineers had done much to advance the science of engineering, but had done little for the engineers themselves.

Col. Greene devoted considerable time to a discussion of engineers as witnesses in court proceedings. He said that engineers were the worst witnesses and that as the witness stand is one of the few places where the engineer came into public view, his poor showing there is one reason for public lack of appreciation of his importance to the community. He explained in his characteristic way why engineers were poor witnesses and pointed out ways in which they could improve their methods.

Walter D. Binger, deputy commissioner, New York City Department of Sanitation, appeared in a dual capacity as the official representative of the mayor and as the head of the engineering division of the sanitation department of the city. Speaking of some of the problems of his division, he stated that a commission such as the one on which he serves either had to build up a large engineering organization of its own or else let out to private consultants the great bulk of its work. For a city of the size of New York with continuing problems of sanitation Mr. Binger believes that the first alternative is the best. On the other hand, he holds that such a department should be free to "hire genius" for special work or to check matter over which special questions arise.

W. Earl Andrews, general manager, New York World's Fair Corp., spoke on the engineering problems and activities of the World's Fair work. On the point discussed by Mr. Binger, Mr. Andrews said that on the World's Fair work about one-third of their engineering was done by their own staff and two-thirds by private practitioners.

Mr. Andrews was followed by Perry T. Ford, secretary, Ohio State Board of Registration for Professional Engineers. Mr. Ford urged that the engineering societies and engineer license boards take more interest in setting up educational standards so that standards will not be set by engineering educators. The educational system, he said, should be adjusted by engineers to meet changing conditions.

Other speakers were Arthur V. Sheridan, president, National Society of Professional Engineers who reported briefly on the progress of the national society, and Alfred E. Roche, the new president of the state society, who spoke on the engineers responsibility in connection with the financing of public work.

New officers elected in addition to Mr. Roche were Frederick H. Zurmuhlen, and Andrew K. Johnson, vice-presidents, E. F. Fox, financial secretary, and P. M. Corry, treasurer.

C.I.O. Grants Charter To Engineers Union

Word has been received by the national office of the Federation of Architects, Engineers, Chemists and Technicians from the Committee for Industrial Organization that the Federation's application for affiliation with the C. I. O. has been approved and that a charter will be issued immediately.

This is stated to be the first charter to be issued to any professional or white collar group by the Committee for Industrial Organization.

Appointee Qualifies for Job As City Engineer

J. S. Waldrep, city engineer of Oklahoma City, who was recently given an indefinite leave of absence until he should qualify for the city engineer's post, to which he had just been appointed, by obtaining a license (*ENR*, May 13, 1937, p. 721), last week obtained a certificate of registration at a special meeting of the state board of registration.

Seattle Engineers Organize

Low salaries and city government favorable to labor cause rapid growth of A.F. of L. organization

Unionization of professional engineers has made rapid progress recently in Seattle; almost all eligibles in the city engineer's office, about 100, and a somewhat larger number in the city light department now are members of the Seattle Association of Technical Engineers and Architects, local 17, affiliated with the American Federation of Labor. The union also has 54 members (almost all of the eligibles) in the King County engineers office, and smaller numbers of members in the city's water, railway, utility and building departments. Engineers in large industrial organizations have joined in representative numbers.

Altogether the Seattle membership now totals 430, of which 155 are licensed engineers. With commitments already made the association expects its city membership to exceed 700 within 30 days. Branches have been established at Tacoma, Olympia and Bremerton, and others are projected for Everett and Spokane. The plan is to build up membership rapidly throughout the state, especially in such large organizations as the state highway department where there are 600 prospective members, aiming at a large majority of the 4,000 engineers in the state. Of this number about 2,000 are licensed and about an equal number are in the non-registered class.

Pay scales low

Impetus for the present move is ascribed to the low pay scale, (particularly for city employees) the prospect for several years of federal and city administrations favorable to labor, and the belief that substantial representation of engineers in such a union would be a means of making the influence of engineers more effective in a collective way. The association was chartered in October 1927 and has had some following prior to the recent rapid growth. To take the city engineer's office as an example, about 30 employees were members before the start of the present drive, and the drive brought in 65 more, which made the office practically 100 per cent unionized.

Many of the new members frankly say that they believe affiliation with a labor body to be an unprofessional move. However, they regard it as an expedient, promising urgently needed improvement in pay scales, for which they see no hope through any other course. In Seattle the engineering pay scale is the lowest on the Pacific Coast and is far below the national average. Many senior employees in the city engineer's office would enjoy considerable wage increases if the union scale were adopted.

The association is organized along lines prescribed by the American Federation of Labor and its bylaws are the standard form used by the national labor body. Thus far no special effort toward organizing the architects has been made, but this is to follow when the engineering field has been canvassed; the number of architects is relatively small. A classification of engineers and a minimum wage scale for each on a basis of monthly (160-hour) and hourly rates has been adopted. These rates are given in the accompanying table, in which the horizontal line separates professional engineers (those who have been licensed) from the non-licensed groups.

Classification of and Rates of Pay for Unionized Engineers at Seattle

	Monthly rate (160 hours)	Hourly rate
Grade 8 — Engineering aide (rear chainman)	$130	$0 81¼
Grade 7 — Senior engineering aide (levelman, rodman, head chain, tracer)......	160	1.00
Grade 6 — Junior engineer (transitman, draftsman)	195	1 22
Grade 5 — Assistant engineer (party chief, structural detailer, construction)	235	1.47
Grade 4—Associate engineer (supervising office force, surveying force; designing draftsman)	280	1 75
Grade 3—Engineer.....	330	2 06
Grade 2—Senior engineer	385	2 41
Grade 1—Principal engineer	445	2 81

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Brief News

Governor Lehman has signed the Doyle-Neustein bill creating a "Little Wagner Act" for New York state (*ENR*, May 20, 1937, p. 758).

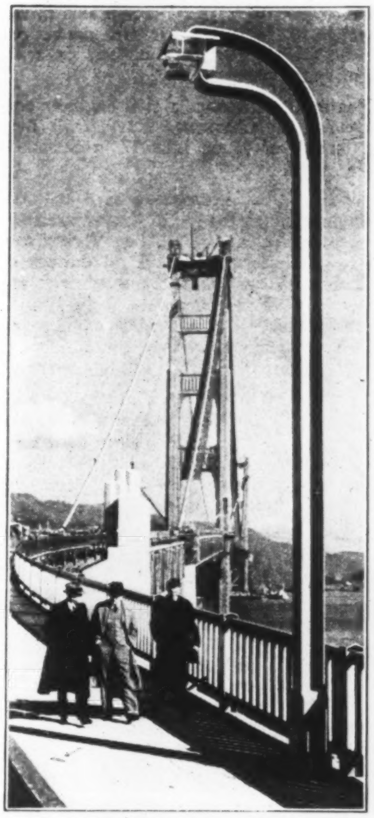
The Flood Control commission created last year in New York State to assist in the formulation of a federal long-range program of flood control in the state is continued until March 15, 1938 by a law recently signed by the Governor.

Long Island water supply will receive further study under the terms of a bill recently signed by Governor Lehman of New York appropriating $25,000 to the New York State Water Power & Control Commission to continue its studies of water supplies in Kings, Queens, Nassau and Suffolk Counties.

The Mexican Ministry of Communications and Public Works has announced its intention of building a railroad connecting Campeche City with Ciudad Chetumal, capital of the Quintana Roo territory, as soon as the Southeastern Railway between Mexico City and Campeche and Yucatan States is completed.

Completion of an additional reservoir in the Lee Valley and of two reservoirs in the Thames Valley, for which $35,000,000 is now available, will add 35,500 acre-ft. to the storage of London's Metropolitan Water Board. Since May 1, 1934 the Board has extended its water-main system by 457 miles.

A High Coefficient of 135 (William and Hazen's Formula) over a 30 year period was allowed for a cement lining centrifugally applied to 17,000 ft. of 48-in. steel pipe recently, as compared with a lesser coefficient for other linings, by the city of Toledo, Ohio. Contract for construction of the pipe line was awarded to C. A. Gillespie Co. of New York City.



SPLIT H-BEAM STANDARDS FOR BRIDGE LUMINAIRES

Lighting on the Golden Gate Bridge at San Francisco will be provided by sodium vapor luminaires of the same design as those used on the Bay Bridge (*ENR*, April 1, 1937, p. 467), but they will be carried on standards made of steel H-beams whose tops have been worked over to provide a convenient support.

The webs in the tops of the beams, as shown above, are split, and the flanges are separated and bent into curves suitable for carrying the luminaires in the desired position 25 ft. above the pavement. Standards on the two sides of the roadway are opposite, instead of being staggered, and are 150 ft. apart.

A 40 Per Cent reduction in the assessed valuation of property on which private water conservation and flood control dams are constructed by the owner is provided in a bill recently signed by Governor Davey of Ohio. Another bill authorizes county commissioners to cooperate with federal and state government agencies in the development of flood control and water conservation programs.

A Hartford flood commission has been set up by the Connecticut legislature to investigate flood problems of the Connecticut and Park Rivers, to improve areas heretofore affected by floods, and to prevent floods by building dikes and reservoirs and to appropriate without reference to the voters up to $5,000,000 for flood control work. The commission will include the mayor of Hartford and eleven members appointed by him.

E. J. Mehren Resigns P.C.A. President

The resignation of Edward J. Mehren, as president of the Portland Cement Association to take effect Aug. 31, was announced by the association on May 25. Mr. Mehren resigned because of his desire to devote his entire time to personal interests in Arizona and in the East.

Mr. Mehren, formerly editor of *Engineering News-Record* and vice-president of the McGraw-Hill Publishing Co., was elected in 1931, the first full-time, paid president of the Portland Cement Association since its formation in 1902.

Mr. Mehren is a member of the Executive Committee of the National Safety Council and of the Policy Committee of the Construction League of the United States. His professional career, following graduation from the Engineering College of the University of Illinois, included some years on railroad construction and other activities, and a long and distinguished service in technical journalism as associate editor and later editor of the "Engineering Record," editor of *Engineering News-Record* and editorial director of the McGraw-Hill publications.

Selection for successor to Mr. Mehren has not yet been announced.

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Personals

Vincent J. Sullivan has been appointed WPA administrator for the state of Connecticut to succeed Robert A. Hurley, who becomes director of the newly established state department of public works.

G. Gale Dixan has been appointed chief flood control engineer for the Pennsylvania Water Power Resources Board, with headquarters at Harrisburg. Mr. Dixan was formerly in charge of the specifications section of the design department of the TVA at Knoville, Tenn.

H. A. Werner, assistant chief bridge engineer of the Maryland State Roads Commission, who has been associated with the commission since 1931, has resigned to become associated with the Wichert Continuous Bridge Corporation of Pittsburgh, Pa., in an engineering capacity. Mr. Werner's resignation becomes effective June 16.

Craig P. Hazelet, formerly president and chief engineer of the Scherzer Rolling Lift Bridge Company, and Ingolf Erdal, formerly chief designing engineer of that company, have begun the practice of consulting engineering, with offices in Chicago, under the firm name of Hazelet and Erdal. The firm will specialize in the design of fixed and movable bridges.

Carawan Nelson, senior engineer in the Jacksonville district of the U. S. Engineers, who has been stationed at district headquarters, has been put in charge of work on the Lake Okeechobee-Caloosahatchee River drainage project, succeeding Capt. G. E. Linkswiler, who has been transferred to Fort Belvoir, Va., to serve as a member of the research board on new equipment and tools for the corps.

Lafayette Higgins, consulting sanitary engineer, Des Moines, Iowa, has gone to

South America to take charge of the construction of a waterworks system for Cartagena, Colombia, for the Raymond Concrete Pile Co. The project, which has been designed in New York, comprises 25 miles of 30 in. concrete pipe to be laid underground, an 8-m.g.d. filter plant, and a cast iron distribution system. The pipe is to be made by the Lock Joint Pipe Co., as subcontractor.

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Obituary

HENRY B. WHITCOMB, 74, for many years commissioner of public works at Hudson, Mass., died in Marlboro, Mass. May 9.

ESTES R. CARPENTER, until his retirement two years ago superintendent of the water department at Ashland, Mass., died in Framingham, Mass., May 9 at the age of 77.

HENRY T. BARNHAM, architect and engineer of Richmond, Va., died there May 18 at the age of 51. Mr. Barnham studied architecture and engineering at the Newark Technical School and at Columbia University. He practiced in New York, Pennsylvania, and Cuba before taking up his Richmond practice in 1914.

CHARLES H. GRAHAM, retired chief engineer of the New York finance department, died in New York on May 20, aged 74. Beginning his service for the city as an assistant to surveyors laying out streets in various villages now incorporated in the borough of the Bronx, Mr. Graham retired in 1933 after 50 years of service with municipal departments.

JAMES C. KINLOCH, a civil engineer employed in the Charleston Navy Yard, died at the age of 63 on May 17 in Summerville, S. C.

WILLIAM B. WORRALL, a civil engineer formerly connected with the New York State Department of Public Works, died in Iowa City, Iowa, Feb. 13 at the age of 83. Mr. Worrall was connected with the New York state department from 1920 to 1930 in the highway division at Hornell, N. Y. Previous to that time he spent many years in the West and elsewhere on railroad location work.

MERTON C. ROBBINS, chairman of the Robbins Publishing Co. of New York City, and western representative at the turn of the century for *Engineering News*, died last week in New York City at the age of 62. Mr. Robbins was founder of the publishing company which bore his name and was an early sponsor of the Audit Bureau of Circulation. He was a graduate in civil engineering of the University of Vermont in 1898.

SILFROY J. FORTIN, formerly consulting engineer to the executive committee of the city of Montreal, and a structural engineer who had practiced in many parts of the world, died in Montreal, May 18, at the age of 71. Mr. Fortin graduated in 1889 from the Civil Engineering School of L'Ecole Polytechnique. After his graduation he practiced in the United States, Honolulu, Japan, China, and Mexico, successively, until 1914, when he entered the service of the Dominion Government at Ottawa on bridge work. In 1918 he became deputy director of public works for the city of Montreal and served the city continuously until his retirement in 1936.

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LARGER AWARDS FOR THE WEEK

Residential development, United Associates' Homes, Jamaica, N. Y.	$12,000,000
Business building, Montgomery-Ward Company, Fort Worth, Tex.	500,000
12-Story hospital, Memorial Hospital, New York, N. Y.	2,800,000
Senior high school, Scarsdale, N. Y.	875,000
Courthouse, Suffolk County, Boston, Mass.	3,087,000
Automotive Vocational High School, Brooklyn, N. Y.	1,078,000
Felician Sisters, Our Lady of the Angels Convent, Enfield, Conn.	750,000
Highways, New York	1,521,000
Highways, Wisconsin	1,202,000
Westchester Avenue Bridge over Bronx River, New York, N. Y.	585,000
Storm water sewers, Brooklyn, N. Y.	1,628,000
Sewers, Contracts No. 5, 6, 7, 8, Greece, N. Y.	638,000
Sewage and garbage treatment plant, Lansing, Mich.	388,000
Park and playground, relief labor, Brooklyn, N. Y.	2,500,000

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
May, 1937	232.65	111.85	Apr., 1937	161	71
Apr., 1937	230.25	110.64	Mar., 1937	147	64
May, 1936	203.40	97.77	Apr., 1936	166	73
1936 (Av.)	206.46	99.24	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50

CONTRACTS
(Thousands of Dollars)

	Weekly Average May 1936	Weekly Average Prev. 4 Weeks	Week May 27 1937
Fed. Government	$3.008	$2.692	$2.446
State and Municipal	22.797	22.432	25.242
Total public	$25.805	$25,124	$27,688
Total private	9,509	29,291	29,928
Week's total	**$35,314**	**$54,415**	**$57,616**

Cumulative to date:
1936 (22 weeks)....................$937.458.000
1937 (21 weeks)....................$971,029,000

Note: *Engineering News-Record* reports **waterworks and earthwork, reclamation or** waterways projects of $15,000 and over in size; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000 and over. The figures above represent the **volume of contracts and large force account** projects throughout the U. S. that are of these **minimum sizes or over.**

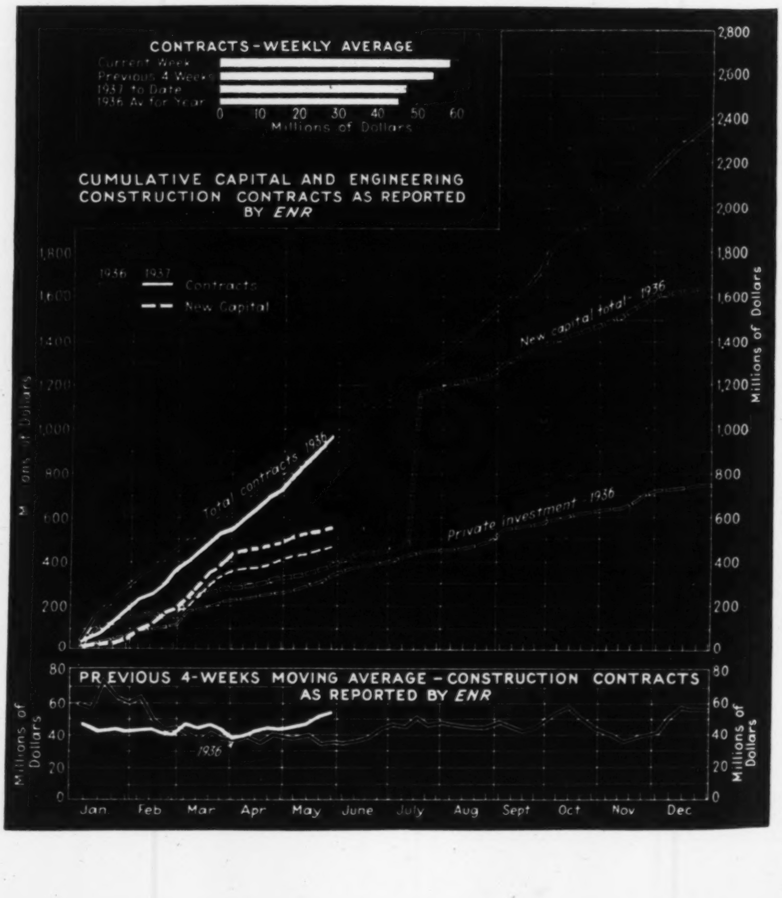
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1937	Week May 27	Cumulative
Private investment	**$17,173**	**$478,857†**
State and municipal bonds	6,151	225,296†
Corporate securities	11,022	253,561
Federal financing	**$390**	**$78,964†**
PWA non-federal Projects	390	49,032
R.F.C. Loan	....	29,932
Total non-federal	**$17,563**	**$557,821**
Federal projects	....	....
Total	**$17,563**	**$557,821**

Cumulative to date:
1936 (22 weeks)....................$397,432,000
1937 (21 weeks)....................$557,821,000

Note: These **figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction;** PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "**self liquidating**" projects, and 25 per cent of **WPA construction appropriations.**

† Includes transfer from **federal to private** investment financing through sale by RFC of PWA bonds.



Construction Equipment and Materials

Adams Hauling Scraper

A new addition to the road building and maintenance machinery line of J. D. Adams Co., Indianapolis, Ind., is the new Adams hauling scraper, manufactured in 5, 6, 8, 10 and 12 yd. sizes. Of all-welded heavy steel plate construction, the scraper is operated by cables from a one or two drum power control unit which is mounted on the tractor and takes its power from the power takeoff shaft.

The depth of cut is adjustable from the tractor operator's seat. After the scraper has been loaded, the bowl is lifted into hauling position and an apron on the front of the scraper is closed with a clam-like action. When the scraper is in hauling position, its entire weight is supported on six large tires and roller bearing wheels.

The power required to pull the scraper ranges from 35-40 hp. for the 5 yd. size to 80-90 hp. for the 12 yd. size.

◆

Four Wheel Scraper Turns In Short Radius

The new four wheel scraper of the Bucyrus-Erie Co., South Milwaukee, Wis., uses a three point suspension, and ample clearance to swivel the front wheels under the frame permits the scraper to be maneuvered in short sharp turns, making a complete circle within the radius of its own length. Because all four wheels are inside the path of the cutting edge, it is said, the scraper digs full width in close quarters and will cut right up against a bank or other obstruction.

The dumping action is stated to be simple, fast and positive. The bowl backs away and tilts forward sharply, while the apron tips and slides ahead.

The frame which carries the unit is box-welded, and the bowl and apron are formed of welded plates of high tensile alloy steel. The replaceable cutting edge is high carbon manganese steel supported on a rigid heat treated steel casting welded into the bowl.

The scraper is regulated by a single cable operating from the drum power unit on the tractor. One lever controls loading, hauling, dumping and spreading.

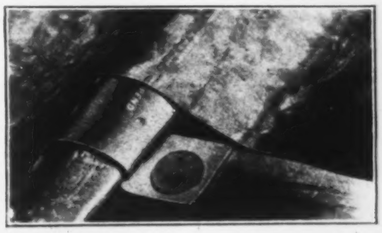
The four wheel scraper is manufactured in two sizes, 4½ yd. capacity and 7 yd. capacity, level measure.

◆

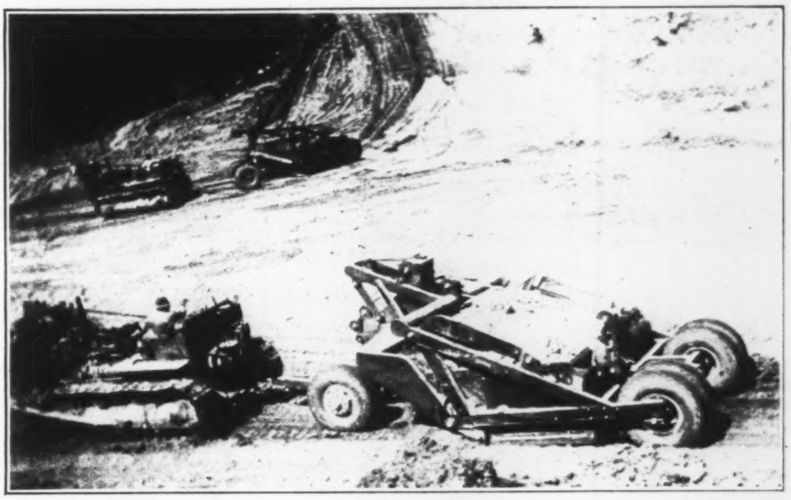
Waterproof Corrugated Roofing Marketed by New Company

The Kor-Lok Co., Union Trust Building, Cleveland, Ohio, has been formed to market an interlocking corrugated sheet for roofing and siding that is said to be waterproof by reason of the elimination of nail holes and capillary attraction.

A simple machine, furnished by the company to Kor-Lok dealers, crimps the sides of ordinary corrugated sheets into an interlocking joint. The sheets are held by a small clip that fits over the curvature along the side of the bottom sheet. The clip is nailed to the wood deck and the top sheet is then slid over it into position, providing, it is said, a firm attachment without nails.



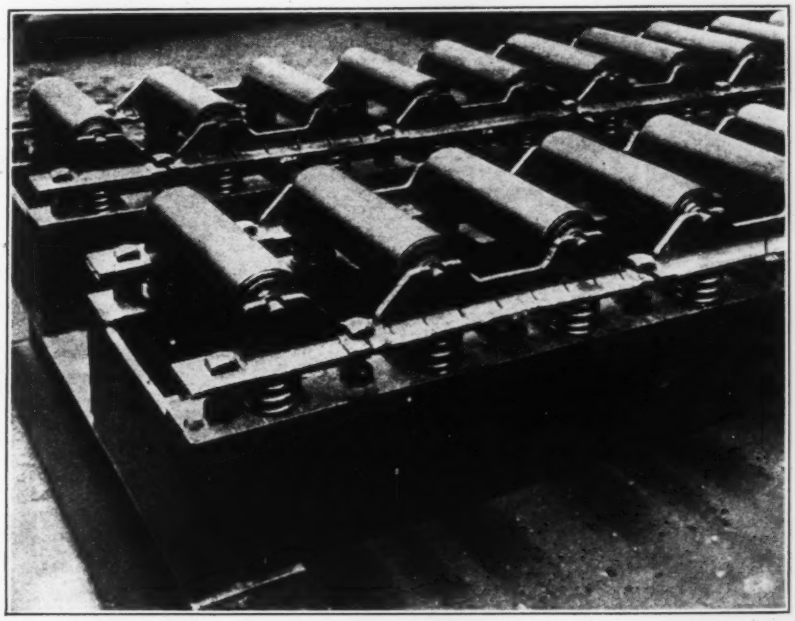
KOR-LOK roof joint



ADAMS 12-yd. hauling scraper at work

SHOCK ABSORBING ROLLER CONVEYOR

A SPRING-MOUNTED roller conveyor has been developed by the Mathews Conveyor Co., Ellwood City, Pa. to meet the conditions imposed by the increasingly heavy loads being carried on roller conveyors. With this design, according to the manufacturers, the rollers will not be injured by the impact of heavy loads dropping on the conveyor; and the weight of long loads is evenly distributed over the rollers under it rather than concentrated on one or two rollers, thus reducing bearing friction and eliminating bearing failure due to overload.



Current Construction Unit Prices

Sewer Outlet Tunnel, Detroit

Owner:

City of Detroit; L. G. Lenhardt, Commissioner of Public Works.

Project:

Outfall conduit of new sewage disposal system, to be built in compressed-air tunnel, 18 ft. inside diameter. Concrete primary lining for land section; structural steel primary lining for river section. Contract includes junction chamber.

Bids:

Opened Feb. 26, 1937. Award of contract delayed until Apr. 1 by controversy over site of disposal plant. Only one bid submitted; contract awarded to lone bidder.

Conditions.

PWA project; PWA labor regulations apply.

Bidder:

S. A. Healy Co., Chicago, Ill. (contract)	$1,610,214

Item	Quan.	Unit Prices
1. Tunnel conduit, 18 ft. I. D., concrete primary lining	5,082 l. f.	$233.00
2. Tunnel conduit, 18 ft. I. D., primary steel lining (river section)	475 l. f.	500.00
3. Concrete secondary ling, conn. to crib	8 l. f.	1,250.00
4. Alignment holes	120 l. f.	6.00
5. Test cores	30 each	100.00
6. Intermediate bulkheads	2 each	5,000.00
7. Junction chamber	Lump sum	125,000.00
8. Government inspection	Lump sum	5,000.00
9. Compressed air plant	Lump sum	30,000.00
10. Engineer's field office	Lump sum	5,000.00

Concrete Paving, Pennsylvania

Owner:

State Highway Department, Jefferson County.

Project:

Construction of 4,745 lin. ft. reinforced concrete pavement, 20 to 36 ft. in width, in Winslow Twp.

Bids:

Opened April 30, 1937. Eight proposals submitted; range $84,623 to $100,373.

Low Bidders:

1. W. N. Quigley, Mifflin	$84,623
2. J. M. Phillips, Muncy	85,643
3. Adam Eddemiller, Greenburg	86,625

Item	Quantity		Unit Prices (1)	(2)	(3)
1. Clearing, grubbing			$500.00	$500.00	$750.00
2. Excavation, Cl. 1	25,091	c.y.	.50	.75	.45
3. Excavation, Cl. 2	96	c.y.	2.00	2.00	2.00
4. Subgrade	19,419	s.y.	15	.12	.12
5. Shoulders	411	l.f.	.20	.15	.30
6. Base, cr. ag. 6 in.	87	s.y.	1.00	1.00	1.00
7. Conc. r.c. pav't	18,419	s.y.	2.80	2.60	2.83
8. Conc. r.c. pav't.	913	s.y.	2.70	2.50	2.83
9. Relay vit. brick pav't	87	s.y.	1.75	2.00	2.50
10. Conc. Cl.B.	12	c.y.	20.00	25.00	20.00
11. Reinf. steel	40	lb.	.06.	.07	.10
12. Stone backfill	1	c.y.	5.00	5.00	5.00
13. Manholes	2	ea.	60.00	70.00	125.00
14. Inlet, Type E	1	ea.	75.00	75.00	80.00
15. Inlet, Type EE	1	ea.	120.00	100.00	160.00
16. Inlet, Type F	10	ea.	100.00	80.00	90.00
17. Inlet box, Type F	2	ea.	75.00	40.00	70.00
18. C.I. pipe, 3 in.	66	l.f.	1.50	1.00	1.50
19. C.I. pipe, 14 in.	256	l.f.	3.00	3.00	2.50
20. C.I. pipe, 16 in.	344	l.f.	3.70	3.50	3.25
21. C.I. pipe, 18 in.	154	l.f.	4.50	4.00	3.90
22. Vit. cl. pipe, 15 in.	326	l.f.	2.20	2.25	2.80
23. Title outlets, 4 in.	30	l.f.	.70	1.00	.80
24. Por. conc. underdrain, 4 in.	780	l.f.	.80	.90	.80
25. Subgrade drains	400	l.f.	.30	.90	.50
26. Conc. curb, 8 in.	34	l.f.	1.25	1.00	1.25
27. Int. conc. curb, 8 in.	8,567	l.f.	.90	.80	1.25
28. Reset curb stone	60	l.f.	.80	1.00	1.00
29. Relay brick sidewalk	186	s.y.	1.50	2.00	2.00

Timber Highway Bridges, Arizona

Owner:

Arizona State Highway Department.

Project:

Three timber highway bridges all within a distance of 2 mi. on Kingman-Boulder Dam highway 15 mi. north of Kingman.

Bids:

Opened Apr. 2, 1937. Six bids submitted; range $18,066 to $24,775. Contract awarded Apr. 6 to low bidder on alternate of Redwood timber in place of treated timber.

Conditions:

NRH project with PWA regulations. Completion date Aug. 15, 1937.

Low Bidders:

1. Lee Moor Contr. Co., El Paso, Tex. (contract) (Treated timber item 3, $605 higher)	$18,066
2. Lewis Bros. Contractors, Inc., Phoenix	18,857
3. Pearson & Dickerson Contractors, Inc., Tempe, Ariz.	21,571

Item	Quan.	UNIT PRICES (1)	(2)	(3)
1. Struc. excav., unclass	992 c. y.	$0.75	$1.00	$0.75
2. Concrete, Cl. B, incl. cement	53 c. y.	14.50	22.00	25.00
3. Treated timber	121 M. b. m.	118.00	113.00	134.00
4. Untreated timber	7 M. b. m.	95.00	80.00	100.00
5. Furnish treated timber piles	1,355 l. f.	.95	.85	1.00
6. Frame piles into bents	126 each	2.00	4.00	2.00
7. Water barrels	8 each	6.00	10.00	10.00
8. Furn. and place oil mix (except road oil)	834 s. y.	.60	0.70	.75
9. Road oil, for bridge cake and seal coat	1,835 gal.	.07	.08	.15
3-A Redwood timber (alternate for items 3 and 4)	134 M. b. m.	107.00	......	......

Highway Bridge, California

Owner:

State Highway Department, C. H. Purcell, chief engineer.

Project:

Highway bridge across Sacramento River at Red Bluff, Calif. Plate girder spans with concrete deck; two 143-ft. spans, one 126-ft. span, two 108-ft. spans, two 96-ft. spans. Concrete piers and abutments on steel pile foundations.

Bids:

Opened May 6, 1937. Nine proposals submitted; range $255,194 to $347,615.

Low Bidders:

1. J. F. Knapp, Oakland, Calif	$255,194
2. Lord & Bishop, Sacramento, Calif	279,215
3. Gates & Huntley, Los Angeles	281,961

Item	Quan.	UNIT PRICES (1)	(2)	(3)
1. Excavation, abutments	1,000 c. y.	$1.50	$1.50	$1.90
2. Excavation, piers	2,800 c. y.	4.50	9.00	8.50
3. Reinforcing steel	390,000 lb.	.054	.0575	.06
4. Concrete footings, Cl. A	950 c. y.	11.00	14.00	12.00
5. Concrete piers, Cl. A	1,700 c. y.	14.00	16.00	15.00
6. Concrete abuts, and superstructure Cl. A	1,810 c. y.	19.00	20.00	27.00
7. Structural steel	1,022,000 lb.	.086	.089	.082
8. Steel railing	1,621 l. f.	8.00	8.25	8.70
9. Cast steel	43,000 lb.	.15	.14	.18
10. Furnish steel piles	15,570 l. f.	1.60	1.65	1.68
11. Drive steel piles	502 each	6.00	11.00	7.50
12. Steel pile splices	50 each	10.00	5.00	8.00
13. Roadway drains	24 each	25.00	30.00	50.00
14. Lighting equipment	Lump sum	5,400.00	5,000.00	4,030.00
15. Remove existing steel truss	Lump sum	1,000.00	1,500.00	1,460.00
16. Misc. items	Lump sum	5,900.00	1,000.00	1,000.00